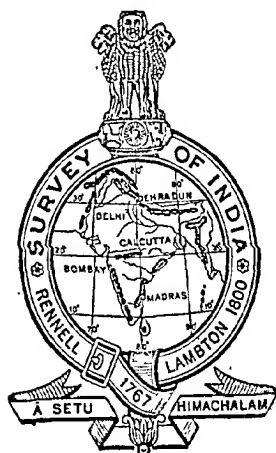




SURVEY OF INDIA

**GENERAL REPORT**

**1950**



From 1st April 1949  
To 31st March 1950

PUBLISHED BY ORDER OF  
COLONEL I. H. R. WILSON, F.R.I.C.S., M.I.S. (IND.)  
SURVEYOR GENERAL OF INDIA

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PRINTED AT THE OFFICE OF THE GEODETIC AND TRAINING CIRCLE,  
SURVEY OF INDIA, DEHRA DUN, 1952.

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## GLOSSARY

Scales are referred to as follows:—

- ( i ) for scales which are multiples of 1/1,000,000—"1/M scale", "1/6 M scale", &c., which mean "1,000,000 scale", "1/6,000,000 scale", &c.,
- ( ii ) for scales smaller than 4 miles to one inch—"50-mile scale", "8-mile scale", &c., which mean "scale of 50 miles to one inch", "scale of 8 miles to one inch", &c.,
- ( iii ) for scales of and larger than 4 miles to one inch—"1/2-inch scale", "1/4-inch scale", "4 inch scale", "16-inch scale", &c., which mean "scale of 1/2-inch to one mile", &c., &c.,
- ( iv ) other scales, by their representative fraction, e.g., "1/25,000".

### Serial Numbering of Survey of India maps

Sheets NE-43, NF-44, &c., are sheets on 1/M scale; ( International Numbering ).  
Sheets 65, 78, &c., are sheets on the 1/M scale; ( now superseded by above ).  
Sheets 65 K, 78 F, &c., are 1/2-inch sheets;  
Sheets 65 K/N.W., 78 F/S.E., &c., are 1/4-inch sheets;  
Sheets 65 K/1, 78 F/16, &c., are 1-inch sheets.

The system of numbering is fully explained in the Indexes at the end of this report.

### Abbreviations—G.C.S. denotes General Central Service.

H.L.O. denotes Hathibarkala Litho Office ( Dehra Dūn ).

P.L.O. denotes Photo-Litho Office ( Calcutta ).

P.Z.O. denotes Photo-Zinco Office ( Dehra Dūn ).

D.O. denotes Drawing Office.

M.R.I.O. denotes Map Record and Issue Office.

A.I.D. denotes All-India Development.

I.C.A.O. denotes International Civil Aviation Organization.



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## PREFACE

### THE HISTORY AND WORK OF THE SURVEY OF INDIA

The first authoritative map of India was published by D' Anville in 1752, when the exploration of the then unknown India was still largely in French hands. It had been compiled from routes of solitary travellers and rough charts of the coast.

The Survey of India may be said to have been founded in 1767—ten years after the battle of Plassey—when Lord Clive formally appointed Major James Rennell the first Surveyor General of Bengal, at that time the most important of the East India Company's possessions.

Rennell's maps were at first military reconnaissances and latterly chained surveys based on astronomically fixed points, and do not pretend to the accuracy of modern maps of India based on the rigid system of triangulation commenced at Madras in 1802 and since extended over and beyond India. Even now, however, the relative accuracy of these old maps makes them valuable in legal disputes, as for instance in proving that the holding of a Bengal landowner was a river area at the time of the Permanent Settlement of 1793, so that he is debarred from its benefits.

From these beginnings, this department has gradually become primarily responsible for all topographical surveys, explorations and the maintenance of geographical maps of the greater part of Southern Asia, and also for geodetic work.

Geodesy means the investigation of the size, shape and structure of the earth, and the geodetic work of the department consists of primary (or geodetic) triangulation, latitude, longitude and gravity determinations. From these the exact "figure" of the earth is obtained, whereby points fixed by triangulation can be accurately located on its curved surface. This system of fixed points holds together all topographical and revenue surveys, and the existence of such a system from the early days of the department has avoided the embarrassments caused in other countries where isolated topographical surveys have been started without a rigid framework, with the inevitable result that they could not be fitted together.

A geodetic framework is therefore essential in any large survey, but there are a number of other activities, all of them ultimately utilitarian, which can be suitably combined with its execution and the following are some of those which have been carried out in India :

Precise levelling for the determination of heights ;  
Tidal predictions and publication of Tide-Tables for thirty-nine ports between Suez and Singapore ;.

The Magnetic survey ;  
Observation of the direction and force of gravity ;  
Astronomical observations to determine latitude, longitude  
and time ;  
Seismographic and meteorological observations at Dehra  
Dūn.

Indian geodesy has disclosed widespread anomalies in the gravitational attraction in the earth's crust which have recently led to a reconsideration of the whole theory of isostasy. Systematic gravity investigations, which may be said to have been initiated in India by the Survey of India, are now being carried out intensively in all civilized countries.

**Topographical Surveys.**—In the past this department used to carry out the large scale revenue surveys for most of India, and conducted this work for Central and Eastern India and Burma till 1905.

Though revenue survey is primarily a record of individual property boundaries and is unconcerned with the surface features, ground levels and exact geographical position essential to a topographical survey, it was on the whole found economical to carry out both surveys together.

By 1905, however, the small scale topographical surveys compiled from the large scale revenue maps had fallen seriously in arrears, owing to the relatively slower pace and incompleteness of the latter, on which non-revenue-paying areas are normally shown blank.

An authoritative Survey Committee appointed by the Government of India considered the position in 1905. It was feared that a separation of the topographical and revenue surveys might result in a wasteful duplication of work and two overlapping but mutually discrepant systems of mapping. These objections were met by a ruling that the basis of both systems of survey should be indetical and provided either by the Survey of India or under its supervision.

Subject to this principle, the remaining revenue surveys were handed over to the provinces, who had always paid for them as part of the overhead charges of revenue collection, and the Survey of India was enabled to concentrate its energies on a complete new series of modern topographical maps in several colours on the 1-inch to 1-mile scale.

This new series had been rendered necessary by the natural demand for more detailed information to be shown on maps, especially as regards the portrayal of hill features by contours and proper classification of communications.

It was intended that the survey begun in 1905 should be completed in twenty-five years, and then revised periodically every thirty years. Owing, however, to the First World War and later retrenchments, only about three fourths of the programme had been

completed by 1939, in spite of a reduction of scale for the less important areas.

Although from 1905 to 1939 new surveys were carried out every year, covering from thirty to sixty thousand square miles—an area roughly that of England—the maps of a large part of the country are still over 50 years old, printed mostly in black only, and have hill features shown by roughly sketched form lines or hachures; such changes in town sites, canals and communications as have been embodied in them have not been surveyed on the ground, but are entered from data gathered from outside sources.

Owing to the serious financial situation in 1931, the establishment of the department was severely cut down and its annual expenditure halved.

During the Second World War, topographical survey work in India practically ceased, and since the conclusion of hostilities the main efforts of the department have been directed to large scale surveys for utilitarian purposes, such as dam sites and areas for irrigation, so that no appreciable progress has been made since 1939 in the 1905 topographical programme.

The obsolescence of the present series of modern maps of India is shewn in Index B at the end of this report.

**Large Scale Surveys.**—Surveys and records of international, state and provincial boundaries have always formed an important item of topographical work, and in recent years numerous Guide Maps have been published of important cities and military stations usually on scales of about 3 inches to the mile, where the 1-inch to 1-mile scale is inadequate.

In 1939, a large scale survey of Lahore on scales of 40 and 100 feet to the inch was undertaken, but owing to the war it was impossible to complete publication of all of the 587 sheets involved, until 1946.

**Miscellaneous.**—So far as work for the Central Government will permit, this department is prepared to undertake local surveys on payment for states, municipal and other local authorities and private firms; and will give advice as to the methods to be employed on such work. Surveys of the above description include:

Forest and cantonment surveys.

Riverain and irrigation surveys.

Railway and city surveys.

Surveys of tea gardens and mining areas.

The department is also equipped to carry out lithographic printing and can undertake such work on payment. Requests for printing should be sent to the Director, Map Publication, Survey of India, Hathibarkala, Dehra Dūn, or Director, Eastern Circle, Survey of India, 13, Wood Street, Calcutta, when estimates of time and cost will be provided.



**Air Survey.**—The use of air photographs for survey purposes has become a normal practice and air survey is employed wherever it is considered advantageous to do so. The Survey of India has arranged with a company in India for the supply, on contract rates, of such photographs as it may require for survey purposes.

Air photographs in pairs for stereoscopic examination or made up in the form of mosaics are very often of value in inspecting sites prior to undertaking detailed survey operations, or may sometimes render these unnecessary. Any demands for air photographs or mosaics should be forwarded to the office of the Surveyor General in Dehra Dun or to one of the Circle Directors who will give quotations.

It may be noted that under the orders of the Government of India all demands for air photography from departments of the Central Government must be placed through the Survey of India.

**Military requirements.**—Prior to the 1939-45 war, the Survey of India was responsible for all survey operations required by the Army. During the war, a Military Survey Service was formed and this Service is retained by the Army in peacetime as a permanent measure. This arrangement relieves the Survey of India of a considerable amount of responsibility for work for the Army, but as the Military Survey Service is likely always to be small, the Survey of India will still be called upon to do a large amount of map production for military purposes.

**Civil Aviation.**—With the establishment of an International Civil Aviation Organization, charts on varying scales to a uniform specification have been planned to cover the whole world. The production responsibility for these charts has, generally speaking, been allotted to the country whose territories cover the part of the globe concerned. In the case of India our commitments are :—

- ( i ) Charts on the 1 : 1,000,000 scale—23 in number.
- ( ii ) Instrument Approach Charts on the scale 1 : 250,000, and Landing Charts on the scale of 1 : 50,000 of all the important Civil Aerodromes in the country. These are printed back-to-back, and are about seventy-two in number.
- ( iii ) Besides the above, charts on the 1 : 500,000 and 1 : 250,000 scales, Route Charts and various Plotting and Planning Charts are planned, but the limits of responsibility and the final implications of these have not yet been settled.

The production of these various series of I.C.A.O. Charts is a new responsibility of this department.

**Administration.**—The administration of the Survey of India was in the hands of the Surveyor General of India under the Ministry of Agriculture. The headquarters office of the Surveyor General of India during the period under report, was in the Old Secretariat at Delhi and was under the administration of the Deputy Surveyor

General. A technical office was attached to this which could provide estimates and make arrangements for any urgent work. There was also a small map issue office in the Old Secretariat.

There were four regional Directors and Survey Circles in addition to a Director of Map Publication. The headquarters of the latter is in Dehra Dūn. There was also a Director, Military Circle up to 29th February 1948, who had a dual civil and military function, being also the Director of Survey, India Command.

The more purely geophysical and mathematical activities of the department were dealt with by the President, Survey Research Institute ( Geodetic Branch ), Dehra Dūn, who exercised many of the functions formerly exercised by the Director, Geodetic Branch ( later Northern Circle ).

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# SURVEY OF INDIA

## GENERAL REPORT

### 1950

From 1st April 1949

To 31st March 1950

#### I. INTRODUCTION AND SUMMARY

1. **Annual Reports.**—Annual Reports of the Survey of India department are published in two separate volumes, namely :—

( a ) *The General Report.*

( b ) *The Technical Report.*

These reports cover the period of the financial year which begins on 1st April and ends on 31st March. The last two reports for 1948-49, which formed the first reports of the department after the partition of India, covered the period from 15th August 1947 to 31st March 1949.

The General Report includes an abstract as well as details of topographical and other surveys ( in *Part I* ), of drawing, printing, publication and map issues, both departmental and extra-departmental ( in *Part II* ) and a brief narrative of geodetic work, preceded by an abstract ( in *Part III* ). The purpose of this report is to acquaint the various departments of the Central and State Governments of India and others who are interested, in language free from technicalities, with the activities of the Survey of India department during the period under review.

The Technical Report, arranged in three parts, on the lines of the General Report, contains figures for areas, out-turn and cost rates of surveys ( including air surveys ), details of surveys and technical methods employed, map drawing and printing, as well as geodetic operations. This Technical Report is intended for departmental use as well as for distribution to other survey and scientific departments.

Part III of the Technical Report which deals with the geodetic and geophysical activities of the department, is generally published as a separate volume.

There is also a supplement to the Technical Report, for departmental use. This Technical Supplement is merely to supply details which are of little general interest, but which are required departmentally to record the output of individuals. It is not printed.

The General and Technical Reports only deal with unrestricted maps and surveys of those areas where the maps are unrestricted.

Particulars of surveys and maps which are "restricted" for security purposes are given in a supplement to the General Report which is a restricted document.

The progress of modern (i.e., since 1905) topographical surveys made by the Department and of compilations from our own or other material is illustrated in *Index A* at the end of this report, while *Index B* indicates the obsolescence of modern surveys. *Index C* shows project surveys in hand and the remaining *Indexes D, E* and *F* show all the standard maps which have been published up-to-date on various scales. It will be seen from *Index D* that the areas within India which are blank on *Index A* are actually almost entirely covered by topographical maps. These maps are, however, prepared from material based on the old longitude of 1815, which was over 2 miles in error, are mostly uncountoured, are drawn in the old style and are many years out-of-date; they are consequently excluded from *Index A*.

It may be mentioned here that besides the standard maps shown in *Indexes D, E* and *F*, this department also publishes aeronautical maps on the 1/M scale of an area covering India and adjacent countries, Landing and Approach Charts on scales of 1/50,000 and 1/250,000 respectively for all civil aerodromes in India, State maps on the 1/M scale, Town Guide maps on scales varying from 3 inches to 16 inches to one mile, general maps of India on scales of 40, 70, 128 and 192 miles to an inch, special maps like the Railway map of India, Road map of India as well as Town maps and Cantonment maps from special surveys.

2. Surveyor General's Office.—BRIGADIER G. F. HEANEY, C.B.E., F.R.I.C.S., held the post of Surveyor General of India throughout the period under report.

The post of Deputy Surveyor General was held by COLONEL GAMBHIR SINGH, throughout the period.

The post of Assistant Surveyor General was held by MR. E. R. WILSON, up to 8th August 1949, after which date this post was held in abeyance. From 9th August 1949, MR. E. R. WILSON was appointed to officiate as Deputy Director in the Surveyor General's Office.

3. Cost of the Department.—The total cost of the department for the year ending 31st March 1950, as compared with that of the previous years was as follows:—

	1947-48	1948-49	1949-50	REMARKS
	Rs.	Rs.	Rs.	
Gross actual cost ..	82,75,984	106,53,860	102,51,223†	†These figures are not final.
Deduct—Recoveries	31,20,188	36,62,974	44,80,173†	
Nett actual charges ..	51,55,796	70,02,886	63,71,050†	

4. *Administration.*—(a) *Formation of a new Geodetic & Training Circle.*—A new Circle known as the “Geodetic & Training Circle” was formed in August 1949. With the approval of the Government of India the post of Director, Western Circle was transferred to Dehra Dun and redesignated as Director, Geodetic & Training Circle. The Government of India also authorized the transfer of the post of Deputy Director from the Northern Circle to the Geodetic & Training Circle.

The Geodetic & Training Circle was to be organized into the following Branches :—

- ( i ) Geodetic and Research Branch.
- ( ii ) Training Branch.
- ( iii ) Statistical Branch.
- ( iv ) Instrument Repair Shop.

( b ) *Gazetted status for some posts.*—The Government of India granted gazetted status to the following non-gazetted officers' posts.—

Assistant Managers, Map Reproduction.

Medical Officer-in-Charge, Hathibarkala Dispensary, Map Publication Office, Dehra Dun.

( c ) *Changes in names and designations.*—The Government of India approved of the following changes in name and designation :—

- ( i ) “Geodetic Branch” ( Survey Research Institute ) was renamed “Geodetic and Research Branch”.
- ( ii ) “Division I ( Field Staff )” personnel of the Class III Service were redesignated “Survey Assistants”.

( d ) *Sanctioned strength of the Department.*—

A statement showing the total number of sanctioned posts in the Survey of India, as on 1st March 1950, is given below :—

Designation of posts		Number	
I. FIXED ESTABLISHMENT :		Permanent	Temporary
( a ) <i>Class I Service.</i> —			
Surveyor General	.. ..	1	..
Directors	.. ..	7*	..
Deputy Directors ( including President, Geodetic & Research Branch	.. ..	2	4
Superintending Surveyors	.. ..	29†	..
Deputy Superintending Surveyors	.. ..	22	1
( b ) <i>General Central Service Class I.</i> —			
Mathematical Adviser	.. ..	1	..
Chief Manager ( Map Reproduction )	.. ..	1‡	..
Deputy Stores Officer	.. ..	..	1
( c ) <i>Class II Service.</i> —			
Officer Surveyors	.. ..	83	..
Officers-in-Charge Administration	.. ..	6	..
( d ) <i>General Central Service Class II.</i> —			
Managers ( Map Reproduction )	.. ..	4	..
Head Engraver	.. ..	1	..
Assistant Managers ( Map Reproduction )	.. ..	8§	..
Assistant Head Engraver	.. ..	1	..

\* 1 post in abeyance.

‡ In abeyance.

† 4 posts in abeyance.

§ 2 posts in abeyance.

Designation of posts			Number	
			Permanent	Temporary
<b>I. FIXED ESTABLISHMENT:—concl.</b>				
<i>(d) General Central Service Class II.—concl.</i>				
Electrical Engineer	..	..	1	..
Senior Scientific Officer	..	..	1*	..
Registrar	..	..	1	..
Officer Supervisors	..	..	..	2
Assistant Stores Officers	..	..	..	2
Medical Officer	..	..	..	1
Cost Accounts Officer	..	..	..	1
<i>(e) Class III Service.—</i>				
<i>(i) Technical.—</i>				
Surveyors	..	..	85	..
Survey Assistants ( Division I )	..	..	30	..
Draftsmen, Division I	..	..	12	..
Engravers, Division I	..	..	7	..
Technical Assistants, Division I	..	..	41†	..
Stores Assistants, Division I	..	..	..	7
Assistant Supervisor, Letterpress	..	..	1	..
Engravers, Division II	..	..	25	14
Medical Officer	..	..	1	..
<i>(ii) Ministerial.—</i>				
Office Superintendents	..	..	3	1
Head Assistants	..	..	2	..
Assistants in Charge	..	..	..	3
Assistants	..	..	10	11
Stenographers	..	..	1	1
Clerks, 2nd Division	..	..	13	11
Clerks, 3rd Division	..	..	8	25
<b>II. UNFIXED ESTABLISHMENT:</b>				
<i>Class III Service.—</i>				
<i>(i) Technical:</i>				
Surveyors (Topographical Assistants and Temporary Computers)	..	..	..	86
Technical Supervisor	..	..	1	..
Head Mechanic	..	..	1	..
Plane-tables, Draftsmen, etc.	..	..	282	624
Reproduction Personnel	..	..	121	315
Head Artificer	..	..	1	..
Assistant Head Artificer	..	..	1	..
Other Artificers	..	..	..	13
Librarian	..	..	..	1
Bookbinder	..	..	1	..
Motor Drivers	..	..	1	55
Compounders	..	..	1	2
Head Packer	..	..	..	1
Assistant Head Packer	..	..	..	1
<i>(ii) Ministerial.—</i>				
Office Superintendents	..	..	6†	1
Head Clerks and Head Accountants	..	..	12	1
Clerks, etc.	..	..	89	210
<i>Class IV Service</i>	..	..	360	1986

*(c) Local Military Ranks to Military Officers holding civilian appointments.*—The President of India sanctioned the grant of local military ranks ( without any benefit of promotion, pay and pension ),

\* In abeyance.

† 1 post in abeyance.

† 6 posts in abeyance.

as specified below to Regular Officers of the Indian Army whilst holding following civilian appointments in the Survey of India :—

<i>Appointment</i>	<i>Rank</i>
Surveyor General ..	Brigadier.
Director of Survey ..	Colonel.
Deputy Director of Survey ..	Lt.-Colonel.
Superintending Surveyor ..	Major.

(f) *Reduction in Stores Organization.*—The following temporary posts in the Stores Organization were abolished from 1st March 1950 :—

Stores Officer ( G.C.S. Class I ) ..	1
Assistant Stores Officers ( G.C.S. Class II ) ..	2
Stores Assistants ( Class III, Division I ) ..	2

5. *Raising, Transfer and Disbandment of Units.*—*No. 14 Party.*—No. 14 Party was transferred from the administrative control of the Director, Northern Circle to that of the President, Geodetic & Research Branch (later Director, Geodetic & Training Circle) with effect from 15th June 1949.

*No. 15 Party and Workshop Section.*—No. 15 Party ( Training ) and the Workshop Section were transferred from the administrative control of the Director, Northern Circle to that of the President, Geodetic & Research Branch, with effect from 1st August 1949.

*Stores Office, Surveys.*—Stores Office, Surveys, was transferred from the administrative control of the Director, Northern Circle to that of the Director, Map Publication, with effect from 1st September 1949.

*Forest Map Office.*—Forest Map Office ( part of No. 2 Drawing Office ) was transferred from the administrative control of the Director, Northern Circle to that of the Director, Map Publication, with effect from 1st November 1949.

*Survey Dispensary and Estate.*—The administrative control of the Geodetic Branch Estate and Dispensary was transferred from the Director, Northern Circle to the Director, Geodetic & Training Circle from 1st November 1949.

*No. 17 Party.*—No. 17 Party ( Southern Circle ) was disbanded with effect from 1st November 1949.

*Move of Surveyor General's Office.*—In December 1949, it was decided to move the Surveyor General's Office from Delhi to Mussoorie, which was expected to take place about the end of April 1950. It is hoped, and the Government of India has agreed in principle, that ultimately the permanent office with residential quarters for the staff will be built on the Hathibarkala Estate, Dehra Dun.

6. *Training.*—Two officers from the Geological Survey of India and two engineers from the Works and Buildings Directorate, Government of West Bengal underwent a short course in air survey from 17th August 1949, in the Eastern Circle.

With the sanction of the Government of India, Mr. A. N. RAMANATHAN, Officer Surveyor, was sent to England in January



1950 for training in the latest methods of Tide Prediction at the Liverpool Tidal Observatory.

7. Deputation.—With the sanction of the Government of India, Mr. A. K. SEN GUPTA, Officiating Superintending Surveyor, was deputed to the Government of West Bengal for a period of three years from 19th August 1949. He will hold the post of Officer-in-Charge, Bengal Survey Party and Drawing Office, and remain under the technical control of the Director, Eastern Circle.

8. Distinguished Visitors.—MAJOR N. B. GADRE, Director (Irrigation) Central Waterpower, Irrigation and Navigation Commission, visited No. 4 Drawing Office, at Bangalore on 11th May 1949. in connection with the air survey work done in the Narbada and Tapti valley Projects.

THE HONOURABLE SHRI JAIRAMDAS DAULATRAM, Minister for Agriculture, Government of India, visited the Map Publication Offices at Hathibarkala, Dehra Dun on 23rd May 1949.

BRIGADIER R. E. ASERAPPA, Engineer-in-Chief in India, visited the Map Publication Offices at Hathibarkala, Dehra Dun on 28th May 1949.

GENERAL K. M. CARIAPPA, Commander-in-Chief, Indian Army, accompanied by MAJOR-GENERAL GURDIP SINGH DHILLON, Commander, U.P. Area, visited the Map Publication Offices at Hathibarkala, Dehra Dun, on 4th June 1949.

MR. J. V. A. NEHEMIAH, Under Secretary to the Government of India, Ministry of Agriculture, visited the Map Publication Offices at Hathibarkala, Dehra Dun, on 18th August 1949.

The delegates to the Survey Priorities Conference held at Dehra Dun on the 19th August 1949, visited the Map Publication Offices at Hathibarkala, Dehra Dun, on 20th August 1949.

BRIGADIER C. R. MANGAT RAI, Chief Engineer, Western Command, New Delhi, visited the Map Publication Offices at Hathibarkala, Dehra Dun, on 1st September 1949.

The Surveyor-in-Charge, Marine Survey of India visited the Southern Circle Offices at Bangalore on 20th September 1949 in connection with the surveys being carried out for the development of Kandla Port.

HIS EXCELLENCY SHRI HOMI MODI, Governor of Uttar Pradesh, visited the Map Publication Offices at Hathibarkala, Dehra Dun, on 20th October 1949.

MR. K. C. BAKHLE, Chief Commissioner of Railways, accompanied by MR. KARNAIL SINGH, Engineer-in-Chief, Assam Rail Link Project, visited the Eastern Circle Offices at Shillong on 29th December 1949.

VICE-ADMIRAL SIR EDWARD PARRY, Commander-in-Chief, Indian Navy, accompanied by Mr. GIBSON of the Inter-Services Wing, Armed Forces Academy, visited the Map Publication Offices at Hathibarkala, Dehra Dun on 14th February 1950.

9. *Conferences and Meetings.—Priorities Conference.*—A Survey Priorities Conference was held by the Ministry of Agriculture in Dehra Dun on the 19th August 1949 to decide on the programme of surveys to be carried out during the season 1949–50. This conference was necessary as the demands for surveys were far in excess of what the department could undertake. Representatives of other Ministries of the Government of India and State Governments and the Directors, Northern and Eastern Circles, Survey of India attended and BRIGADIER G. F. HEANEY, C.B.E., F.R.I.C.S., Surveyor General of India presided in the absence of the Secretary, Ministry of Agriculture.

*Institution of Surveyors in India.*—A meeting of the Sub-Committee appointed by the Department of Scientific Research was held at the Surveyor General's Office, Delhi on 22nd September 1949, to draw up a plan for the formation of an Institution of Land Surveyors in India, on the lines of those of the Royal Institution of Chartered Surveyors in the United Kingdom. BRIGADIER G. F. HEANEY, C.B.E., F.R.I.C.S., Surveyor General of India took the chair while MAJOR-GENERAL H. WILLIAMS, C.B.E., Engineer-in-Chief in India, DR. D. S. KOTHARI, Scientific Adviser to the Ministry of Defence and representatives of the Ministry of Education, Central Public Works Department, Department of Scientific Research and Survey of India attended the meeting.

A second meeting of the above-mentioned Sub-Committee was held at the Surveyor General's Office, Delhi on the 19th October 1949 under the chairmanship of the Surveyor General when the Memorandum of Association and Rules of the proposed Institution of Surveyors were finalized and the recommendations of the Committee for the formation of this Institution were submitted to the Government of India for approval.

*Map Restriction Policy.*—The Surveyor General of India and the Deputy Director, Surveyor General's Office, attended a Conference on "Map Restriction Policy" at the Ministry of Agriculture, New Delhi on 7th November 1949. The Conference was attended by the representatives of the Ministries of External Affairs and Defence.

10. *Lectures.*—BRIGADIER G. F. HEANEY, C.B.E., F.R.I.C.S., Surveyor General of India, delivered a lecture on the work of the Survey of India to the students at the Inter-Services Wing of the Armed Forces Academy, Clement Town, Dehra Dun on 23rd August 1949.

The Surveyor General again gave a talk on the history and activities of the Survey of India to the Officers of the Ministry of Agriculture at the Central Secretariat on 16th September 1949.

COLONEL R. T. L. ROGERS, Director, Eastern Circle, delivered the following lectures in Calcutta :—

- (a) To the Civil Engineers of the Government of West Bengal at request of the Chief Engineer, Works and Building, on "Air Photography and its uses in planning Engineering Projects"—on 12th July 1949.

(b) To the post-graduate students of the Bengal Engineering College :—

(i) "Mapping from air photography"—on 6th December 1949.

(ii) "Air photography and its uses in planning Engineering Projects"—on 10th January 1950.

11. *Miscellaneous.—Economy measures.*—Owing to the financial stringency, orders were received that savings in the net expenditure of the department under the heads "pay and allowances and contingent charges" were to be effected during the financial year 1949-50. Various economy measures were put into effect, e.g., postponement of the establishment of the Instrument Repair Shop, disbandment of No. 17 Party, and abolition of temporary posts in the Stores Organization. Many vacant posts including the post of Chief Manager, Map Reproduction, also remained unfilled.

*Exhibition at Roorkee.*—The Survey of India took part in the exhibition at Roorkee held in connection with the centenary celebrations of the Thomason College of Engineering. Two officers were in charge of the Survey exhibits comprising special maps, original plane-table sections, special survey and geodetic instruments.

*Survey of India Crest.*—The new design of the Survey of India crest which appears facing the inside cover page of this Report was approved by the Government of India and will replace the previous crest. The Asoka Chakra and Lions, symbols of the Indian Republic, replace the Tudor Crowns and a Sanskrit motto '*ā setu himachalam*', which means 'from the sea to the mountains', replaces the Latin motto "*a montibus ad mare*". The name of Rennell, the first modern Indian Geographer, replaces that of Everest, as being a more important figure in the history of survey work in India.

12. *Personnel.*—Retirements, casualties, promotions, appointments, etc.—

*Class I Officers.*—COLONEL G. H. OSMASTON, M.C., LT.-COLONEL H. W. WRIGHT, O.B.E., and MAJOR R. H. SAMS, R.E., retired.

COLONEL I. H. R. WILSON retired from the army and was granted the honorary rank of Colonel; he was re-employed on a five-year contract as Director.

COLONEL R. S. KALHA confirmed in the grade of Director.

MAJOR R. T. L. ROGERS, R.E., Director, Eastern Circle and MAJOR GAMBHIR SINGH, I.A., Deputy Surveyor General were granted the local rank of Colonel; MAJOR J. S. PAINTAL, R.I.E., Officiating Deputy Director, was granted the local rank of Lt.-Colonel.

MR. B. L. GULATEE appointed to officiate as Director, Geodetic & Training Circle.

MESSRS. K. L. DHAWAN, P. A. THOMAS, E. R. WILSON, M. M. GANAPATHY and J. C. BERRY—appointed to officiate as Deputy Directors.

T/LT.-COLONEL P. D. JOSHI, R.I.E. and T/MAJOR R. C. TYAGI, R.I.E.—reverted to Army.

MESSRS. P. S. SHINGHAL, N. L. GUPTA, H. H. PHILLIPS, L. J. BAGNALL, N. D. JOSHI, S. C. CHATTERJEE and A. K. SEN GUPTA—confirmed in the grade of Deputy Superintending Surveyor.

MESSRS. J. CHATTERJEE, G. C. AGGARWALA, U. D. MANGAIN, M. W. KALAPPA, V. KRISHNAMURTHY, and B. B. KUTTAPPA—appointed to officiate in the grade of Deputy Superintending Surveyor.

Mr. N. C. NATH—substantively appointed as Officer-in-Charge, Map Record & Issue Office.

MESSRS. J. C. SIKKA, K. S. SINGH, R. S. CHUGH and V. P. SHARMA appointed to officiate as Deputy Superintending Surveyors

*Class II Officers.*—MESSRS. C. SIVARAMAN, S. R. M. LOUIS G. B. DAS, K. VENKATARAMAN, I. C. DEB, J. C. SEN GUPTA, B. K. SATPATHI, SUKHWANT RAI, B. S. RATTAN, S. P. BANERJI, H. K. CHOPRA, T. C. JYOTI and P. RAMAMOORTHY—confirmed in their appointments as Officer Surveyors.

Mr. P. C. SEN GUPTA—re-employed as Officer Surveyor continued.

Mr. A. R. J. DALZIEL, Head Engraver (G.C.S. Class II)—granted leave preparatory to retirement.

Mr. G. A. H. THOMAS—re-employed as Assistant Manager Map Reproduction (G.C.S. Class II).

Mr. P. DAS GUPTA—appointed as Assistant Head Engraver (G.C.S. Class II).

Mr. STANLEY MICHAEL—appointed to officiate as Assistant Manager, Map Reproduction (G.C.S. Class II).

Mr. P. N. BANERJI, Registrar (G.C.S. Class II)—transferred to the Indian Police Service.

*Class III Service.*—MESSRS. N. C. ROY, A. K. MAITRA, B. P. RUNDEV, P. K. CHOUDHURY, N. M. BOPIAH, L. R. HOWARD J. B. MATHUR and GOVIND PRASAD—appointed as Surveyors, Selection Grade.

MESSRS. SUKOMAL DAS GUPTA, SOHAN SINGH, INDRA SINGH RAWAT and C. M. AZIMUDDIN—appointed as Survey Assistants Selection Grade.

MESSRS. I. M. SAKLANI, B. S. TOMAR and POORAN CHAND—appointed as Survey Assistants, Ordinary Grade.

Mr. S. K. BANERJI—Draftsman, promoted to Division I Selection Grade.

MESSRS. M. L. BANERJI, C. M. MANGAIN and K. P. GANGULI—Draftsmen, promoted to Division I, Ordinary Grade.

MR. A. GHAFAR, Engraver—promoted to Division I, Selection Grade.

13. Deaths—Deaths of the following personnel of the Class III Service are noted here with regret :—

Mr. Hoshiar Chand Gupta, Surveyor, Grade I.

Mr. S. A. Wahab, Plane-tablet, Division II.

Mr. Sheikh Yassin, Machine Feeder.

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## PART I.—TOPOGRAPHICAL AND OTHER SURVEYS

### II. ABSTRACT OF SURVEYS AND TOPOGRAPHICAL WORK

14. The following two tables indicate the progress achieved in the topographical survey programme assigned to the Department in 1905 and give details of the work done during the period under report.

*Table A* shows the area of survey completed on various scales since 1905, as well as the approximate balance which remains to complete the contoured topographical survey of India.

*Table B* shows the area revised during the period under report.

There is also a *Table C*, showing in detail the survey operations carried out during the period under report, together with their cost rates. This *Table C* is now published in the Technical Report.

It may be mentioned here that it was decided in 1905 that a completely new contoured survey should be undertaken of India on a scale of 1-inch to a mile and that the survey was to be completed in 25 years and thereafter completely revised at 25-year intervals. For various reasons the original programme was only about three quarters completed on the outbreak of war in 1939, and practically no topographical survey operations were carried out during the war and the pre-partition period. After the partition of India, work on the original programme of surveys has been resumed and the two *Tables A* and *B* below show the progress made at the end of the period under report :—

**Table A.—Progress of Topographical Surveys in India since 1905**

Survey Years	1 inch and larger scales	$\frac{1}{2}$ and $\frac{1}{4}$ inch scales	$\frac{3}{4}$ and $\frac{1}{2}$ inch scales	TOTALS
	Sq. miles	Sq. miles	Sq. miles	Sq. miles
1905-45 ..	7,68,673	1,94,572	57,724	10,20,969
1945-49 ..	8,773	..	..	8,773
1949-50 ..	609	..	..	609
Totals to 1950 ..	7,78,055	1,94,572	57,724	10,30,351
Balance (Approximately) ..	1,20,775	*29,624	87,950	2,38,349
Total programme ..	..	..	..	†12,68,700

\* Subject to alterations on final decision on the scale of surveys to be undertaken.

† Revised area of India excluding Pākistān, Nepal, Bhutan and Sikkim but including foreign possessions in India.

Table B.—Revision and Resurvey of above work during the year

Survey Years	1 inch and larger scales	$\frac{2}{3}$ and $\frac{1}{2}$ inch scales	$\frac{3}{4}$ and $\frac{1}{4}$ inch scales	TOTALS
	Sq. miles	Sq. miles	Sq. miles	Sq. miles
1949-50 ..	2,426	..	*5,650	8,076

\* Includes 4,160 Sq. miles of verification survey.

15. Although the primary survey responsibilities of the Survey of India are geodetic, topographical and geographical, the department has to undertake a considerable amount of special surveys in connection with irrigation, hydro-electric, land reclamation and similar development projects, and to meet demands for large scale surveys of cities, cantonments and industrially important areas. It has also to advise and assist the State Governments with local and settlement surveys as may be required. Since the war, surveys for irrigation and similar projects have largely occupied the resources of the Survey of India to the exclusion of departmental work.

The following sub-heads show the various types of work and field operations carried out by the department during the period :—

Boundary surveys	Geophysical work
Cantonment and other large scale surveys for the Defence Services	Rectangulation
City surveys	Levelling
Contoured photo mosaics	Topographical framework
Geodetic framework	Topographical surveys by air and ground methods
	Training

An abstract of surveys in each State of the Indian Republic is alphabetically arranged and given below. If a State is not mentioned, no work has been done there during the period under report.

#### 16. Assam.

*Contoured photo mosaics* in Abor Hills district of North-East Frontier Agency ( p. 33 ).

*Levelling*.—Tertiary simultaneous double levelling and tertiary single levelling in Abor Hills district of North-East Frontier Agency ( p. 27 ).

*Topographical framework*.—Triangulation, traverse and supplementary height control in Abor Hills district of North-East Frontier Agency and in Darrang district ( p. 27 ).

*Topographical surveys by air methods*.—Original survey in Darrang, Kamrup and Nowgong districts ( p. 28 ). Revision survey in Nowgong and Sibsagar districts ( p. 33 ).

*Topographical surveys by ground methods*.—Revision survey in Lakhimpur district ( p. 32 ).

#### 17. Bihār.

*Levelling* of secondary precision in connection with Gandak and Kosi projects ( p. 69 ). Secondary levelling in Hazāribāgh and

Saran districts and tertiary levelling in Saran district ( p. 32 ).  
Double and single tertiary levelling in Purnea and Bhagalpur districts ( p. 30 ).

*Topographical framework*.—Traversing in Purnea and Bhagalpur districts ( p. 30 ).

*Topographical surveys by air methods* in Purnea, Bhagalpur and Hazāribāgh districts ( pp. 30, 31 ). Rapid revision from air photographs in Darbhanga, Monghyr, Muzaffarpur, Patna and Saran districts ( p. 28 ).

*Topographical surveys by ground methods*.—Revision survey in Gaya district ( p. 32 ).

#### 18. Bilaspur.

*Levelling* for Bhakra Reservoir survey ( p. 18 ).

*Topographical framework*.—Triangulation for above ( p. 17 ).

*Topographical surveys by ground methods* for above ( p. 17 ).

#### 19. Bombay.

*Levelling* of high precision of the line Kolhapur to Kārwar, Kārwar-Hubli Section ( p. 68 ). Double tertiary levelling in Bombay Suburban and Belgaum districts and levelling in Ahmedabād, Sabar Kantha, Surat and Navsari districts ( pp. 37, 40 ).

*Topographical framework*.—Triangulation in West Khandesh, Surat, Bombay Suburban, Belgaum, Idar, Danta, Kolaba, Navsari and Sabar Kantha districts ( pp. 37, 40 ).

*Topographical surveys by ground methods* in Ahmedabād, Bombay Suburban, Belgaum and Sabar Kantha districts ( pp. 37, 40 ).

#### 20. Delhi.

*Levelling*.—( p. 18 ).

*Topographical surveys by ground methods*.—( p. 19 ).

*Topographical surveys by air methods*.—( p. 18 ).

#### 21. Himachal Pradesh.

*Topographical framework*.—Triangulation in Sirmur district ( p. 17 ).

*Topographical surveys by ground methods* in Sirmur district ( p. 18 ).

#### 22. Hyderābād.

*Levelling*.—Double and single tertiary levelling in Raichur district ( p. 42 ) and tertiary levelling in Raichur and Mahbubnagar districts ( p. 42 ).

*Topographical framework*.—Triangulation and stone-laying in Raichur district ( p. 42 ).

*Topographical surveys by air methods* in Raichur district ( p. 43 ).

*Topographical surveys by ground methods* in Atrāf-i-Balda district ( p. 42 ).

#### 23. Kutch.

*Geodetic framework*.—Measurement of a geodetic base ( p. 67 ).

Geodetic triangulation ( p. 67 ). Twin laplace observations ( p. 67 ).

*Geophysical work*.—Determination of the deflection of the vertical ( p. 64 ). Tidal observations ( p. 66 ).



*Levelling*.—( p. 69 ).

*Topographical surveys by air methods*.—( p. 39 ).

*Topographical surveys by ground methods*.—( p. 39 ).

#### 24. Madhya Bharat.

*Topographical surveys by ground methods* in Gwalior district ( p. 19 ).

#### 25. Madhya Pradesh.

*Boundary surveys* between Rewa and Korea ( p. 18 ).

*Levelling* of secondary precision in Upper and Lower Narbada Division ( p. 69 ). Tertiary levelling in Bastar, Raipur and Sarangarh districts ( p. 32 ).

*Topographical framework*.—Triangulation and height control in Bastar and Raipur districts ( p. 17 ). Planimetric and height control in Betul, Hoshangabad and Nimar districts ( p. 17 ). Triangulation and traversing along Rewa-Korea boundary ( p. 18 ). Stone-laying in Sarangarh district ( p. 32 ).

*Topographical surveys by air methods* in Chhindwara, Jabulpore and Mandla districts ( p. 19 ).

#### 26. Madras.

*Levelling* of high precision—Raipur to Vizagapatam ( p. 68 ).

*Levelling* in Chingleput and Trichinopoly districts ( p. 37 ).

*Topographical framework*.—Triangulation in Chingleput, Trichinopoly and Kurnool districts ( p. 37 ).

*Topographical surveys by air methods* in Cuddapah and Nellore districts ( p. 38 ).

*Topographical surveys by ground methods* in Chingleput and Trichinopoly districts ( p. 37 ).

#### 27. Mysore.

*Levelling* in Bangalore district ( p. 37 ).

*Topographical framework*.—Triangulation in Bangalore district ( p. 37 ).

*Topographical surveys by ground methods* in Bangalore district ( p. 37 ).

#### 28. Orissa.

*Levelling* of high precision in Balasore district ( p. 68 ). Tertiary levelling in Patna and Sambalpur districts ( p. 32 ).

*Topographical framework*.—Stone-laying in Patna and Sambalpur districts ( p. 32 ).

*Topographical surveys by air methods* in Sambalpur and Sonapur districts ( p. 33 ).

*Topographical surveys by ground methods*.—Revision surveys in Puri district ( p. 32 ).

#### 29. Patiala & East Punjab States Union.

*Levelling*.—Tertiary levelling in Patiala and Jind ( p. 20 ).

*Rectangulation* in Patiala and Jind ( p. 20 ).

*Topographical framework*.—Triangulation and stone-laying in Patiala and Jind ( p. 21 ).

*Topographical surveys by ground methods*.—Verification of major detail in Patiala and Jind ( p. 21 ).

## 30. Punjab.

*Levelling*.—Tertiary levelling in Ambala, Hissar and Karnal districts ( p. 21 ).

*Rectangulation* in the above districts ( p. 20 ).

*Topographical framework*.—Triangulation in Ambala, Hoshiarpur, Karnal and Jullundur districts ( p. 21 ). *Stone-laying* in Ambala, Hissar and Karnal districts ( p. 21 ).

*Topographical surveys by ground methods* in Karnal, Gurgaon and Rohtak districts ( pp. 18 ).

## 31. Rajasthan.

*Levelling* in Jaipur, Jodhpur and Kishanganrh ( p. 18 ).

*Topographical framework*.—Triangulation in the above areas ( p. 18 ).

*Topographical surveys by ground methods* in the above areas ( p. 18 ).

## 32. Saurashtra.

*Topographical framework*.—Triangulation and traversing in Kathiawar Agency ( p. 38 ). Triangulation in Central Saurashtra and Halar districts ( p. 39 ).

*Topographical surveys by air methods* in Central Saurashtra ( p. 36 ).

*Topographical surveys by ground methods* in Kathiawar Agency ( p. 36 ).

## 33. Uttar Pradesh.

*Topographical framework*.—Triangulation in Dehra Dūn district ( p. 18 ).

*Topographical surveys by ground methods* in Bulandshahr, Meerut and Dehra Dūn districts ( p. 18 ).

## 34. Vindhya Pradesh.

*Boundary surveys* between Rewa and Korea ( p. 19 ).

*Topographical framework*.—Triangulation and traversing along Rewa-Korea boundary ( p. 19 ).

## 35. West Bengal.

*City surveys* in Calcutta, 24-Parganas and Howrah districts ( p. 34 ).

*Levelling* of high precision and precision in Calcutta, 24-Parganas and Howrah districts ( p. 68 ).

*Topographical surveys by ground methods*.—Revision surveys in 24-Parganas district ( p. 32 ).

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### III. SURVEY REPORTS, NORTHERN CIRCLE

DIRECTOR :— $\left\{ \begin{array}{l} \text{Mr. B. N. Saha, M.Sc., to 3-9-49.} \\ \text{Lt.-Col. J. S. Paintal, I.E., from 4-9-49 to 20-11-49.} \\ \text{Mr. B. N. Saha, M.Sc., from 21-11-49.} \end{array} \right.$

DEPUTY DIRECTOR :—Mr. K. L. Dhawan, B.A., to 31-7-49.

36. Summary.—The units administered by the Circle were No. 1 Party, No. 13 Party, No. 14 Party (upto 14-6-49), No. 15 Party (upto 31-7-49), No. 20 (Cantt.) Party, No. 2 Drawing Office and Stores Office, Surveys (upto 31-8-49).

#### 37. Areas Surveyed.—

- 2.1 square miles of 32-inch original ground survey.
- 9.1 square miles of 8-inch original ground survey.
- 31.3 square miles of 4-inch original ground survey.
- 189 square miles of 2-inch original ground survey.
- 2.1 square miles of 32-inch original air survey.
- 272.5 square miles of 4-inch original air survey.
- 500 square miles of 1-inch verification survey.
- 8 square miles of  $\frac{1}{2}$ -inch verification survey.
- 300 square miles of  $\frac{3}{8}$ -inch rapid revision survey.
- 420 square miles of supplementary triangulation.
- 1,855 square miles of triangulation.
- 246 linear miles of levelling.
- 16 linear miles of traversing.
- 220 square miles of height control for air survey.
- 1,000 square miles of  $\frac{1}{4}$ -inch rapid revision survey.
- 1,894 square miles of rectangulation to 100 acres.
- 2,307 square miles of tertiary levelling to 25 acres.
- 17 linear miles of boundary verification.
- 36,050 acres of 4-inch ground survey.
- 3,103 acres of 8-inch ground survey.
- 14,983 acres of 16-inch ground survey.
- 5,159 acres of 24-inch ground survey.
- 250 acres of 64-inch ground survey.

#### No. 1 PARTY

Officer in charge :— $\left\{ \begin{array}{l} \text{Mr. N. L. Gupta, C.E., to 12-7-49.} \\ \text{Mr. P. S. Shinghal, C.E., from 13-7-49.} \end{array} \right.$

38. General.—The party continued to be employed on extra-departmental surveys for irrigation and other development schemes in Bilāspur, Delhi, Himāchal Pradesh, Madhya Bhārat, Madhya Pradesh, Punjab, Rājasthān, Uttar Pradesh, and Vindhya Pradesh. In view of heavy demands for extra-departmental surveys the normal topographical survey programme of the unit remained virtually suspended as in previous years.

Recess headquarters remained at Dehra Dūn.

Field headquarters moved to Sāmbhar Lake, a central place from where supervision of camps, scattered over a large area, could be exercised with increased efficiency and economy.

A training class was organized at Dehra Dūn for the training in air-cum-ground surveys of about 13 draftsmen and topographical trainees. Nearly four-fifths of the effective strength of the unit took the field; the remainder was employed on mapping.

39. **Personnel.**—The average strength of the party was 1 Class I officer, 5 Class II officers, 48 Class III personnel, and 13 topographical trainees and draftsman.

40. **Areas Surveyed.**—

- 2.1 square miles of 32-inch original ground survey.
- 9.1 square miles of 8-inch original ground survey.
- 31.3 square miles of 4-inch original ground survey.
- 189 square miles of 2-inch original ground survey.
- 2.1 square miles of 32-inch original air survey.
- 272.5 square miles of 4-inch original air survey.
- 500 square miles of 1-inch verification survey.
- 8 square miles of  $\frac{1}{2}$ -inch verification survey.
- 300 square miles of  $\frac{3}{8}$ -inch rapid revision survey.
- 420 square miles of supplementary triangulation.
- 320 square miles of triangulation.
- 246 linear miles of levelling.
- 16 linear miles of traversing.
- 220 square miles of height control for air survey.
- 1,000 square miles of  $\frac{1}{4}$ -inch rapid revision survey.

41. **Field Work.**—The field work was organized and completed as under :—

(i) *Tawa Reservoir Survey.*—The camp under the supervision of Mr. Suresh Prasad (Class II) with Mr. T. C. Jyoti (Class II), Mr. D. D. Mehta (Surveyor), 2 Survey Assistants and 5 Plane-tablers completed 300 square miles of supplementary triangulation and 220 square miles of height control in Hoshangābād and Betūl districts of Madhya Pradesh.

(ii) *Punāsa Reservoir Control.*—Mr. Sohan Singh (Survey Assistant) carried out supplementary planimetric control over 120 square miles of an area, falling in Nimār district of Madhya Pradesh.

(iii) *Bhākra Reservoir Survey.*—Mr. R. S. Chhabra (Surveyor) carried out triangulation and completed nearly 10 square miles of original ground survey on 4 inches to 1 mile scale. Later on Mr. R. S. Chugh (Class I) was placed in charge of this camp, consisting of 2 Class II officers, 2 Surveyors, 2 Survey Assistants and 3 Plane-tablers.

25 square miles on 4 inches to 1 mile scale of original ground survey and nearly 50 square miles of supplementary triangulation and e-heighting were completed by the end of March 1950 in Bilāspur

State and Hoshiarpur and Kangra districts of the Punjab. In addition to this, double tertiary levelling of 19 linear miles was carried out, and the 1,280 feet contour was demarcated on the ground in the area of the reservoir for a distance of 15 miles.

(iv) *Jumna Hydro-electric Scheme*.—Mr. Ratna Singh (Surveyor) and Mr. Jai Kirti Singh (Survey Assistant), carried out 20 square miles of triangulation. Thereafter 3 draftsmen trainees under the supervision of Mr. Gurdit Singh (Survey Assistant) as instructor, completed 2.1 square miles of original ground survey on 32 inches to 1 mile scale and 4.5 square miles of ground survey on 4 inches to 1 mile scale in the districts of Sirmūr (Himāchal Pradesh) and Dehra Dūn (Uttar Pradesh).

(v) *Didwāna Salt Lake*.—Mr. Arjan Dev (Class II) with one Plane-tableter completed 15 square miles of triangulation, 29 linear miles of tertiary levelling, and 9.1 square miles of 8-inch original ground survey in Jodhpur (Rājasthān).

(vi) *Sāmbhar Lake*.—Mr. R. S. Chugh (Class I) carried out over 225 square miles of triangulation around Sāmbhar Lake in Jaipur, Jodhpur and Kishangarh (Rājasthān) for 2-inch scale original ground survey of the lake. The survey was commenced in January, 1950 under the direct supervision of the officer in charge of the party with Mr. Arjan Dev (Class II) as assistant, and 1 Surveyor, 1 Survey Assistant and 3 Plane-tablers. 184 linear miles of tertiary levelling and detail survey of 125 square miles of the area were completed by the end of March 1950, when Mr. Arjan Dev was placed in charge of the camp to carry on the supervision independently.

(vii) *Landing and Approach Charts for Pālam Airport*.—Mr. H. K. Chopra (Class II) assisted by Mr. Sohan Singh (Survey Assistant), completed, in Delhi, 32 square miles of 2-inch scale original survey and 14 linear miles of tertiary levelling, required for compilation of Pālam Landing Chart on 1/50,000 scale in accordance with the specifications laid down by the International Civil Aviation Organization. An area of about 1,000 square miles, covering the airport and its surroundings, was gone over completely by Mr. Sohan Singh (Survey Assistant), who verified the existing 1-inch maps of the area, for main roads, railways and main rivers, and heights were obtained for all obstructions and hazards to air navigation in conformity with the specifications laid down by the International Civil Aviation Organization for an Approach Chart on 1/250,000 scale. The area comprised Delhi, Gurgaon and Rohtak districts of the Punjab and Bulandshahr and Meerut districts of Uttar Pradesh.

(viii) *Korea-Rewa Boundary Dispute*.—Mr. C. L. Puri (Surveyor) with Mr. Sohan Singh (Survey Assistant) and B. S. Tomar (Plane-tableter), demarcated 16 miles of disputed boundary, for which they completed 60 square miles of triangulation, 16 linear miles of traverse and 1.8 square miles of 4-inch original ground survey in Madhya Bhārat and Vindhya Pradesh. The positions of boundary pillars were

fixed by theodolite traverse with reference to an old existing triangulation point of 1867.

(ix) *Verification Survey*.—Verification survey of about 8 square miles comprising Harsi Reservoir and its environs in Gwalior (Madhya Bhārat) was completed on a  $\frac{1}{2}$ -inch published sheet by Mr. R. P. Kukreti (Survey Assistant).

The entire area, approximately 500 square miles, covering the 'Delhi and Locality' 1-inch map, was verified on the ground.

(x) *Training*.—Training class of the party under Mr. Govind Prasad (Surveyor) assisted by Mr. R. S. Negi and Mr. Nasib Singh (Survey Assistants) as instructors, trained a batch of 13 topographical trainees and draftsmen in elementary air and ground surveys.

42. *Recess (1949) Duties*.—The party was organized into 3 drawing and air survey sections and 1 computing and miscellaneous sub-section under Messrs. Suresh Prasad (Class II), R. S. Chugh (Class I), and H. K. Chopra (Class II) and Govind Prasad (Surveyor) and the following jobs of air survey and fair mapping were completed:—

(i) *New Delhi Development*.—52 sheets on 100 feet to 1-inch scale of the north area and 2 sheets covering Lodi Colony were completed for incorporation of ground verification corrections and heading and footnotes.

(ii) *Agra Central Railway Station*.—3 sheets on 32 inches to 1 mile scale were completed for incorporation of ground verification corrections and heading and footnotes.

(iii) *Rewa and Satna Towns*.—3 sheets on 16 inches to 1 mile scale were completed for incorporation of ground verification corrections and heading and footnotes.

(iv) *Bargi Reservoir*.—Air survey on 4 inches to 1 mile scale with 20 and 10-foot contours of the entire 173 square miles area of the proposed reservoir was completed in 7 sheets in Chhindwara, Jubbulpore and Mandla districts of Madhya Pradesh.

(v) *Bargi Dam-site*.—Air survey on 32 inches to 1 mile scale with 5-foot contours was completed for an area of 2.1 square miles.

(vi) *Photomosaic of Bargi Reservoir*.—Contouring at 20 and 10-foot vertical intervals was completed on 4-inch scale photo-mosaics in 7 sections.

(vii) *Rāmganga Reservoir*.—Air survey on 4 inches to 1 mile scale with 20-foot contours was completed for an area of 99.5 square miles in 4 sheets.

(viii) *Patiāla Development*.—Air survey for three separate areas on 16 inches to 1 mile scale with 20-foot contours was completed in 5 sheets.

(ix) *Korea-Rewa Boundary Dispute*.—Fair mapping on 4 inches to 1 mile scale of original survey of a strip, 200 yards wide, along the boundary under dispute was completed in 2 sheets.

*Computing and Miscellaneous Sub-section.*—The sub-section remained fully occupied during the recess with computations and scrutiny of field framework and the collection and conversion of trigonometrical data for field season 1949-50.

### No. 13 PARTY

*Officer in charge.*—{ Mr. F. M. Hawley, to 2-4-49.  
Mr. T. M. C. Alexander, from 3-4-49.

43. *General.*—The party continued rectangulation in the area commanded by the Bhakra Dam in the Punjab and Patiala & East Punjab States Union for the Punjab Government. Recess headquarters of the party remained at Mussoorie. Field headquarters opened at Karnāl on 31st October 1949.

44. *Personnel.*—The average strength of the party was 1 Class I officer, 2 Class II officers, 5 Surveyors, 1 Survey Assistant and 67 other Class III personnel, including clerks. Five of the Class III personnel joined on 20th December 1949 on transfer from No. 17 Party (S.C.).

#### 45. Areas Surveyed.—

1,100 square miles of triangulation for future traverse and rectangulation.

435 square miles of revision triangulation of the area triangulated during the previous field season.

1,894 square miles of rectangulation to 100 acres.

2,044 square miles of tertiary levelling to 25 acres.

263 square miles of revision tertiary levelling to 25 acres in part of area already completed.

Verification survey of major detail in two 1-inch sheets.

#### 46. Field Work.—The field work was organized as under :—

*Camp (1) (Rectangulation).*—Mr. A. C. Chowla (Class II) with one Surveyor and 16 other Class III personnel completed 900 square miles of rectangulation to 100 acres in Hissār and Karnāl districts of the Punjab and in Patiala & East Punjab States Union.

*Camp (2) (Levelling).*—Mr. R. L. Ghei (Class II) took over charge of the camp from Mr. A. N. Malhotra (Surveyor) from 26-1-50. He with Mr. A. N. Malhotra and 16 other Class III personnel completed 938 square miles of tertiary levelling to 25 acres in Ambāla and Karnāl districts of the Punjab and in Patiala & East Punjab States Union. Levelling computations were carried out *pari passu* by a small section consisting of 2 computers.

*Camp (3) (Rectangulation).*—Mr. Amar Singh (Surveyor) with 1 Surveyor and 12 other Class III personnel completed 994 square miles of rectangulation to 100 acres in Ambāla and Karnāl districts of the Punjab and in Patiala & East Punjab States Union. This camp started field work on 3rd October 1949 and consisted of 22 Class III personnel in the beginning. The number of Class III personnel was gradually decreased later to strengthen other camps.

*Camp (4) (Levelling).*—Mr. N. B. Chowdhury (Surveyor) with 15 other Class III personnel completed 1,106 square miles of tertiary levelling to 25 acres in Hissār and Karnāl districts of the Punjab and in Patiāla & East Punjab States Union. Levelling computations were carried out *pari passu* by a small section of 2 computers.

*Camp (5) (Levelling and Drawing).*—Mr. Dayanand (Surveyor) with 2 other Class III personnel carried out revision levelling (for east and west spot heights along 100-acre lines only) in 263 square miles of area in Hissār district of the Punjab. After the completion of this job towards the end of December 1949, he closed his camp and with 2 draftsmen took up fair drawing and mapping work for the above sheets, at the party headquarters.

*Triangulation.*—Mr. Dial Singh (Survey Assistant) completed 1,100 square miles of triangulation in Ambāla, Hoshiārpur and Jullundur districts of the Punjab, and Patiāla & East Punjab States Union. He also carried out revision triangulation in an area of 435 square miles in Ambāla and Karnāl districts of the Punjab and in Patiāla & East Punjab States Union.

*Verification Surveys.*—Messrs. A. N. Malhotra and R. L. Taneja (Surveyors) carried out verification surveys of major detail in two 1-inch sheets in Karnāl district of the Punjab and in Patiāla & East Punjab States Union.

47. *Description of Country.*—The area covered by rectangulation and levelling consists of flat and densely wooded plains with occasional patches of cultivation in the north and east and cultivated fields in the south and west. The northern and eastern portions of the area are affected by floods from the Ghaggar and Saraswati rivers and this greatly impeded the progress of work. The country triangulated during the year consists of open cultivated plains interspersed with trees.

48. *Recess Work.*—During recess, 125 sheets for the area which was rectangulated and levelled during the previous field season, were fair drawn and completed by five drawing sections under :—

- ( i ) Mr. A. C. Chowla ( Class II ).
- ( ii ) Mr. Amar Singh ( Surveyor ).
- ( iii ) Mr. Dayanand ( Surveyor ) to 18-6-49.  
Mr. A. N. Malhotra ( Surveyor ) from 19-6-49.
- ( iv ) Mr. Mohan Ram ( Surveyor ) to 3-7-49.  
Mr. N. B. Chowdhury ( Surveyor ) from 4-7-49.
- ( v ) Mr. Dial Singh ( Survey Assistant ).

#### No. 15 PARTY

*Officer in charge* :—Mr. K. L. Dhawan, B.A., to 31-7-49.

49. *General.*—The headquarters of the unit remained at Dehra Dūn throughout the period under report. It was transferred



to the charge of the Director, Geodetic & Training Circle with effect from 1st August 1949.

50. **Personnel.**—The average strength of the party was 1 Class I officer, 1 Class II officer and 9 Class III personnel (4 Surveyors, 4 Clerks and 1 Store-keeper).

51. **Training.**—The strength of the trainees was 4 R.I.E. officers, 4 Class II probationers, 5 Burmese officers, 6 Class III officers (Temporary Computers) and 12 Topographical Trainees, Type 'B'.

Two Temporary Computers were posted to other duties under the Geodetic & Training Circle being unlikely to make suitable field officers.

### No. 20 (CANTONMENT) PARTY

*Officer in charge.*—Mr. M. D. Nangia, B.A.

52. **General.**—The party surveyed cantonments and bāzār areas and other military lands in the Western, Eastern and Southern Commands at different scales in accordance with the programme approved by the Ministry of Defence.

The field season commenced on the 16th of September 1949. The headquarters of the party remained at Dehra Dūn for both field and recess seasons.

53. **Personnel.**—The average strength of the party was 1 Class I Officer, 1 Class II Officer and 54 Class III personnel, including 6 clerks and 9 trainees.

54. **Recess duties.**—

( i ) Ambāla Sadar Bāzār Extension—6 sheets were completed for fair drawing and sent for publication.

( ii ) Meerut Cantonment Bāzār :—

( a ) 3 sheets completed for fair drawing and sent for publication.

( b ) 6 sheets partially completed for fair mapping.

( iii ) Agra Cantonment Bāzār—9 sheets—Taken up for fair mapping.

### STORES OFFICE, SURVEYS

*Stores Officer.*—Mr. N. T. Wadhvani, B.Sc.

55. **General.**—The 100% physical check of stores commenced in June 1948 was completed by the end of June 1949.

Division of stores between India and Pākistān continued during the period under report and several items of stores urgently required by the Government of Pākistān were handed over.

A system of control over certain items of map reproduction stores instituted to conserve the small stocks of such stores,

continued in force during the period under report. This control was operated in consultation with the Director, Map Publication.

The supply position of certain stores only procurable from abroad, e.g., brushes, sable hair, glass plates, improved during the period under report, on receipt of consignments.

The administrative control of the Stores Office was transferred from the Director, Northern Circle to the Director, Map Publication with effect from the afternoon of 31-8-49.

56. Personnel.—Average strength of the office was :—

2 Class I ( G.C.S. ) Officers.

2 Class II ( G.C.S. ) Officers.

53 Class III personnel.

97 Class IV personnel.

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#### IV. SURVEY REPORTS, EASTERN CIRCLE

DIRECTOR:— Colonel R. T. L. Rogers, M.A. (CANTAB.).

DEPUTY DIRECTOR:— { Mr. M. M. Ganapathy, B.A. to 31-8-49 and again from  
29-10-49.  
Mr. J. C. Ross, from 1-9-49 to 28-10-49 (Current  
duties).

57. Summary.—The following units and offices were administered by Eastern Circle :—

Nos. 5, 9, 11, 12 Parties, No. 5 Drawing Office, Engraving Office, Photo-Litho Office and Map Record & Issue Office. Reports on the working of the four latter units are contained in Part II of this report.

All the above parties were employed on extra-departmental surveys during the year under report. These surveys were in connection with hydro-electric and irrigation projects, geological investigations, town planning and air field surveys in accordance with the specifications laid down by the International Civil Aviation Organization. Some departmental 1-inch original and 1-inch revision surveys had initially been included in the field programme but these had to be postponed in favour of "paid-for" work due to the financial stringency. For the same reason, drastic reductions were made in numbers of Class IV personnel and motor vehicles allowed to field parties.

58. Areas Surveyed.—

- 267 square miles of triangulation for control of 4-inch air surveys.
- 434.5 linear miles of traverse for control of 4-inch and 16-inch air surveys.
- 112.4 linear miles of secondary levelling for 4-inch irrigation surveys.
- 152 linear miles of double tertiary levelling for establishing bench-marks at the Dihāng dam site and commanded area.
- 646.2 linear miles of double tertiary levelling for 4-inch irrigation surveys.
- 10197.6 linear miles of tertiary levelling for 4-inch irrigation surveys.
- 71 square miles of supplementary height control for 4-inch air surveys.
- 2175 square miles of correction survey of existing 1-inch maps from air photography.
- 1178.4 square miles of 4-inch revision air survey of outline only.



Original Tista Bridge  
on Assam Rail Link  
before construction of  
the extensions due to  
the flood wash-out of  
each abutment.



14.5 square miles of 4-inch ground survey.

1.1 square miles of 16-inch ground survey.

7 square miles of ground verification of air photographs for 16-inch air survey.

1053 square miles of stonelaying and ground verification for 4-inch irrigation surveys.

152.2 square miles of  $1\frac{1}{2}$ -inch revision survey for air-field landing charts.

3806 square miles of  $\frac{1}{4}$ -inch verification survey for air-field approach charts.

86 square miles of 1-inch revision air survey (outline only).

182 square miles of 4-inch revision air survey.

67.8 square miles of 6-inch revision air survey (outline only).

29 square miles of 6-inch revision air survey (contours only).

37 square miles of contouring on air photo-mosaics.

59. Training.—A short air survey course was held in Shillong during recess at which the following personnel were trained :—

2 Assistant Geologists of the Geological Survey of India.

2 Assistant Engineers of the West Bengal, P.W.D.

6 Surveyors.

5 Plane-tablers and Draftsmen.

Survey parties also held courses during recess for training levellers as draftsmen.

One Officer of the Assam Survey Department was given a three month's course in the Photo-Litho Office, Calcutta.

### No. 5 PARTY

*Officer in charge*:—Mr. K. C. Gosain, B.A.

60. General.—Before the beginning of the field season, this party was allotted some normal departmental field work of one-inch original and revision surveys in West Bengal and Bihār and 1/25,000 revision surveys in Assam for Garo Hills Coalfields; but due to financial stringency, these tasks had to be abandoned at the last moment when all arrangements for taking the field had almost been completed. The activities of the party were thus entirely diverted to extra-departmental large scale surveys for the State and Central Governments, and for a Tea Estate firm (Messrs. Jardine Henderson Ltd., of Calcutta), who required maps for various diverse purposes such as river flood control, irrigation and hydro-electric schemes, determination of land holdings and railway bridge projects in Assam, Bihār and West Bengal.

The Party headquarters remained at Shillong throughout the year. The duration of the recess was only  $4\frac{1}{2}$  months from the middle of June to the end of October.

61. **Personnel.**—The average strength of the party, which fluctuated throughout the year under report, was 1 Class I Officer, 2 Class II Officers and 40 Class III personnel (including 7 Surveyors, 2 Survey Assistants, 1 Division I Draftsman, and Plane-tables, Draftsmen, Clerks, Store-keepers and Record-keepers). During recess, 3 Surveyors, 1 Plane-table and 1 Draftsman were attached to No. 12 Party for a short course in air survey and 10 Levellers, Topographical Trainee Type 'B', were trained in fair-drawing. During the field season, 1 Class II Officer, 1 Survey Assistant and 9 Levellers were attached to Nos. 9 and 11 Parties.

62. **Areas Surveyed.**—

187 square miles of triangulation for 4-inch Dihāng Reservoir, 16-inch Dihāng Dam and Tea Estates (air surveys).

184 linear miles of theodolite traverse for planimetric control for Dihāng Reservoir and Tea Estates (air surveys).

71 square miles of supplementary height control for Dihāng Reservoir.

152 linear miles of tertiary simultaneous double levelling for Dihāng Dam and the Commanded Area.

775 square miles of rapid revision of existing one-inch maps from air photographs for Ganga Bridge Project.

200 square miles of 4-inch revision air survey for Kopili River Flood Control Scheme.

7 square miles of ground verification of photographs for 16-inch Tea Estate air survey.

63. **Field Work.**—The field work was organized as follows:—

*Camp I.—Dihāng Dam—Headquarters at Pasighāt.*—Mr. D. Biswas (Class II) completed in 3 months (January to March) 4.5 square miles of triangulation in Abor Hills for outline air survey of Dihāng Dam area.

*Camp II.—Dihāng Dam—Headquarters at Pang-in (40 miles north-west of Pasighāt).*—A. K. Sen Gupta (Class II).

Assistants for planimetric and height control:—Messrs. J. C. Sen Gupta (Class II), D. Sen, H. S. Iyer, J. K. Chatterjee and S. K. Datta (Surveyors), and one Division II Class III Plane-table. Mr. S. N. Sanyal (Surveyor) and Mr. D. Biswas, (Class II) were sent in February and April respectively, as reinforcements.

Assistants for double tertiary and single tertiary levelling:—Messrs. S. K. Datta and A. H. Sarkar (Surveyors) for 2 months, Mr. S. N. Sanyal (Surveyor) for 1 month and 2 Levellers (Topographical Trainee Type 'B') for 2 months.

The camp carried out the following jobs in Abor Hills district of the North-East Frontier Agency :—

- 168 square miles of minor triangulation for providing points to control theodolite traverses and planimetric control for 4-inch air survey.
- 144 linear miles of theodolite traversing.
- 71 square miles of supplementary height control by clinometer and ground verification of air photographs.
- 152 linear miles of tertiary simultaneous double leveling for establishing bench-marks at the Dam site and in the Commanded Area.

*Camp III.*—Mr. A. K. Roy (Surveyor) carried out 7 square miles of ground verification of air photographs and 40 linear miles of theodolite traverse (without heights) to provide planimetric control for 16-inch air survey of Tezpur and Gogra Tea Estate in the district of Darrang, Assam.

Besides the three Camps in the field, there was an air survey and drawing section at the party headquarters under Mr. S. N. Roy (Surveyor) assisted by Mr. B. K. Sarkar (Draftsman Division I), Mr. N. K. Pal Chowdhury (Surveyor) and 8 draftsmen. This section completed the fair mapping of 7 sheets of Kopili Flood Control Scheme on 4-inch scale comprising 120 square miles of revision air survey in Kāmrup and Nowgong districts, Assam.

64. Description of country.—(a) *Dihāng Reservoir and Dam Area.*—It extends from the south foothills of the Abor Hills to Bomdo in the Dihāng valley, from Yekshing to Pakshing in the Siyom valley, from Ponging to Dukku in the Yamne valley, altogether covering nearly 220 miles in length and, on an average, 1·2 miles in width.

The area, though small, is extremely mountainous and difficult for survey. The Dihāng itself and its tributaries run in deep, narrow and tortuous gorges. Wherever the valleys widen out, bold precipitous spurs run down steeply from the crest of the ranges bordering each valley down to river level. The hills are covered with dense forests of huge trees, interlaced with very thick undergrowth, mainly of bamboos and wild bananas in dense clumps, defying almost every attempt of clearance.

Communications are extremely bad; with the exception of two footpaths—one from Pasighāt to Pang-in and the other from Pang-in to Along—all other pathways existing at present have no easy gradient; they invariably go up hill and down dale and present innumerable obstacles to laden porters. The main rivers have only a few selected places (15 to 30 miles apart) which can be crossed by ferries or tubular cane bridges. One main motorable road from Pasighāt to Rotung and a footpath about 4 feet wide along the east bank up to the dam site are under construction.



Other difficulties encountered were the weather, transport and rations. Only for 3 months from November to January, the weather remained favourable; afterwards, rain, mist and haze prevented the use of helios and/or lamps. On an average, there were only 12 working days in each of the three months of February, March and April. The local inhabitants, the Abors, are good porters; but were unavailable in sufficient numbers especially between Pang-in and Pasighāt. They were generally averse to working unless handled tactfully and/or forced by their village councils. Supplies were scanty except Abor rice, and that only up to the end of February. Other items of rations had to be carried from Pasighāt or Pang-in to the survey camps by porters over the hills, often in very inclement weather.

On the advice of the Political Officer, military escort parties were engaged for work north of Riga in the Dihāng valley to protect the survey personnel in case of any hostile action by the hill tribes. No such hostilities were encountered.

Life in Abor Hills is extremely unsophisticated; and, people from the plains have got to unlearn much of their conventions before they can adapt themselves to the Abor life.

(b) *Tea Estate Area*.—Country in the Darrang district is generally open and gently undulating with occasional patches of high grass and jungle.

65. *Health*.—Health, on the whole, was good. In the Dihāng area, one Class IV servant died of heart failure and Mr. S. N. Sanyal (Surveyor) fell sick and had to be withdrawn from field.

66. *Recess Duties*.—Recess work was organized as follows :—

*Section I* under Mr. J. C. Sen Gupta (Class II) up to July and later under Mr. S. N. Roy (Surveyor), with 2 Surveyors and 6 Draftsmen carried out the following :—

(a) 775 square miles of rapid revision of existing one-inch maps from air photos in the districts of Darbhanga, Monghyr, Muzaffarpur, Patna and Saran in Bihar.

(b) 80 square miles of revision air survey on 4-inch scale for Kopili Flood Control, in the districts of Darrang, Kāmrup and Nowgong in Assam.

*Section II* under Mr. S. D. Gupta (Survey Assistant) with 5 Draftsmen completed fair drawing of 11.7 square miles, comprising 5 sheets of the 16-inch Jamshedpur Town Extension series.

*Section III* under Mr. K. S. Loverwell (Survey Assistant) with 5 Plane-tables and Draftsmen carried out the plotting of tertiary level lines for one foot contouring of Kopili Flood Control sheets.

*Section IV* under Mr. B. K. Sarkar (Division I Draftsman) was a training section in which 10 Levellers (Topographical Trainee Type 'B') were trained in fair-drawing.

*Computing Section* under Mr. A.K. Maitra (Surveyor) with six computers carried out all computations of project surveys, executed in 1948-49 by Nos. 5 and 12 Parties and several other miscellaneous computations, such as, providing initial data to units of the Eastern Circle and to other Directorates and departments, and adjustment of various topographical data.

Computations of the Dihāng Reservoir instrumental observations were done partly in the field by one computer : these are to be completed, checked and duplicated in recess, 1950.

## No. 9 PARTY

*Officer in charge*:—Mr. H. H. Phillips, B.Sc. (HONS.).

67. *General*.—All the surveys carried out by the party were in continuation of those done previously to meet the requirements of the Central Waterpower Irrigation and Navigation Commission for the Kosi Irrigation Project.

The field headquarter of the party was at Purnea in Bihār, and its recess headquarter was at Mussoorie in the Dehra Dūn district of Uttar Pradesh.

68. *Personnel*.—The average strength of the party was 1 Class I Officer, 3 Class II Officers, 10 Surveyors, 61 Class III personnel (including plane-tablers, draftsmen, levellers and computers), 7 clerks, a store-keeper and 5 motor drivers.

### 69. Areas Surveyed.—

250.5 linear miles of traverse for 4-inch Kosi irrigation surveys.

332.8 linear miles of double tertiary levelling for 4-inch Kosi irrigation surveys.

2,808 linear miles of tertiary levelling for 4-inch Kosi irrigation surveys.

1.5 square miles of ground survey for 4-inch Kosi irrigation surveys.

1054 square miles of stonelaying and ground verification for air survey for 4-inch Kosi irrigation surveys.

13 square miles of 4-inch ground survey for the proposed West Kosi canal headworks.

432 square miles of 4-inch air survey of outline only of Kosi irrigation sheets.

1400 square miles of correction survey, from air photographs, of 1-inch maps for the course of the Kosi river.

### 70. Field work.—Field work was organized as follows :—

*Camp I*.—Mr. Mohindar Singh (Class II), in charge, with 1 plane-tablet and 7 levellers completed the stonelaying, tertiary levelling and ground verification for air survey of 10 Kosi irrigation sheets comprising 270 square miles. The camp was reinforced by 1

plane-table and 1 leveller in the month of February 1950. A computing section of 5 computers, under the administration of this camp completed the checking and field computations of all tertiary levelling done in Camps I, II, III and IV. The camp headquarters was at Forbesganj.

*Camp II.*—Mr. B. S. Rattan (Class II), in charge, with 1 plane-table and 7 levellers completed the stonelaying, tertiary levelling and ground verification for air survey of 10 Kosi irrigation sheets comprising 270 square miles. The camp was reinforced by 1 plane-table in the month of February 1950. The camp headquarter was at Forbesganj.

*Camp III.*—Mr. R. D. Verma (Surveyor), in charge, with 1 plane-table and 7 levellers completed the stonelaying, tertiary levelling and ground verification for air survey of 10 Kosi irrigation sheets comprising 270 square miles. The camp was reinforced by 1 plane-table and 1 leveller in March 1950 and by 1 more plane-table in April 1950. Up to the 15th March the camp headquarter was at Pratāpganj and thereafter at Tribeniganj.

*Camp IV.*—Mr. N. C. Naug (Surveyor), in charge, with 1 plane-table and 7 levellers completed the stonelaying, tertiary levelling and ground verification for air survey of 9 Kosi irrigation sheets comprising 243 square miles. The camp was reinforced by 1 plane-table and 1 leveller in February 1950. Up to the 15th March the camp headquarter was at Pratāpganj and thereafter at Tribeniganj.

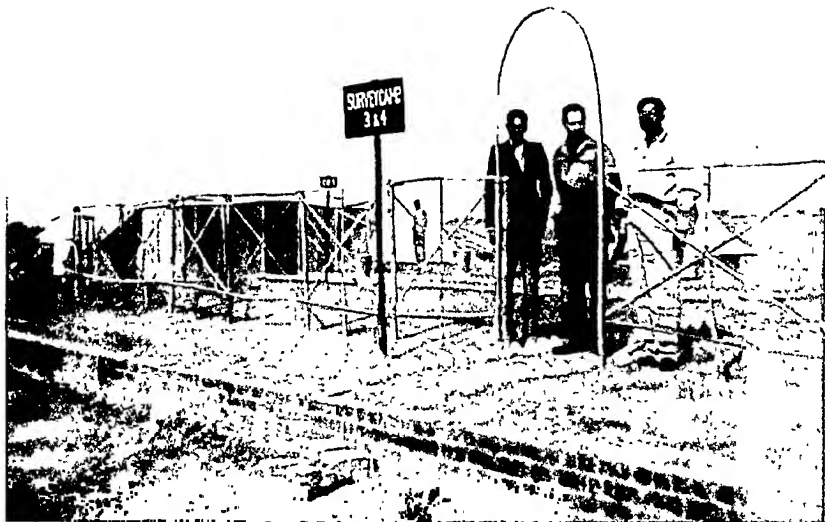
*Planimetric control.*—Mr. S. K. Ghose (Surveyor), assisted by Mr. V. R. C. Shahane (Surveyor), completed 250.5 miles of traverse to provide the planimetric control for the air survey compilation of 4-inch Kosi irrigation sheets.

71. *Description of Country.*—The area surveyed lies astride most of the former beds of the Kosi river and consists of flat plains partially cultivated. To the east the country is very open, but nearer the present course of the Kosi there are large tracts of land covered with high grass and occasional *babul* trees. The high grass abounds with wild boar and deer; bluebull, wild buffalo and panther are also to be found.

In the dry season most of the unmetalled roads are deeply rutted and motorable with difficulty, whereas some of the ordinary cart-tracks offer more comfortable motoring.

72. *Health.*—The health of the party remained good. Malaria was completely controlled by taking Paludrine in prophylactic doses. Cholera broke out in epidemic form in the villages in the south-east part of the Kosi area in the month of March and continued till the end of the field season, but with inoculations and the ordinary precautions being observed, survey personnel were not affected.

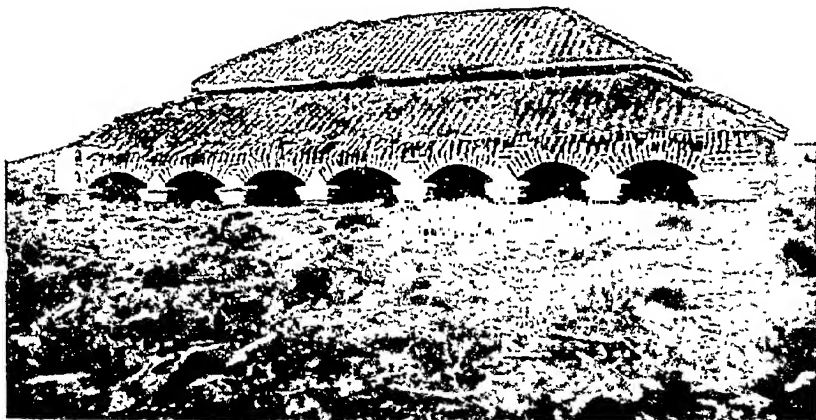
73. *Recess Duties.*—The party was organized into an air survey section under Mr. K. R. Basu (Surveyor), 3 drawing sections



RAVAGES CAUSED BY KOSI RIVER FLOODS.

*Top*.—CAMP H.Q.'s OF NO. 9 PARTY ON DISUSED STATION PLATFORM OF RAILWAY LINE WHICH WAS OBLITERATED BY FLOODS.

*Bottom*.—HOUSE SILTED UP TO HEIGHT OF 5 FEET.



*Top.* IN CONNECTION WITH GANDAK PROJECT SURVEYS—*L.* TO *R.* AIRCRAFT  
PILOT EXECUTIVE ENGINEER, GANDAK BARRAGE PROJECT; DEPUTY  
SURVEYOR GENERAL, SECRETARY, IRRIGATION & P.W.D., GOVERN-  
MENT OF BIHAR

*Bottom.* IN CONNECTION WITH Kosi PROJECT SURVEYS.

for Kosi irrigation mapping under Messrs. Mohindar Singh ( Class II ), R. D. Verma ( Surveyor ) and S. N. Barthwal ( Surveyor ) respectively, and a computing section under Mr. P. C. Datta ( Computer ).

The compilation, computations and fair mapping of 20½ Kosi irrigation sheets were completed.

## NO. II PARTY

*Officer in charge* :—Mr. S. C. Chatterjee, B.Sc. ( HONS. ).

74. **General.**—The party was employed on 4-inch surveys for the Mahānadi ( Hirākud ) and Gandak irrigation projects, surveys in connection with the production of airfield approach and landing charts according to the specifications laid down by the International Civil Aviation Organization, a large scale airfield survey for the Ministry of Defence, and the provision of control for a dam site and reservoir survey in connection with a proposed hydro-electric project on the upper reaches of the Mahānadi river.

The party headquarters continued to be at Rānchi.

75. **Personnel.**—The average strength of the party was 1 Class I Officer, 4 Class II Officers and 63 Class III personnel including 7 clerks.

76. **Areas Surveyed.**—The various types of work completed were as follows :—

80 square miles of triangulation for Upper Mahānadi reservoir area.

112·4 linear miles of secondary levelling for Gandak Barrage area.

313·4 linear miles of double tertiary levelling for Gandak Barrage area.

1827·3 linear miles of tertiary levelling for Mahānadi ( Hirākud ) project.

5562·3 linear miles of tertiary levelling for Gandak Barrage area.

546·4 square miles of 4-inch outline air survey for Mahānadi ( Hirākud ) project.

152·2 square miles of 1½-inch revision survey for landing charts.

3806 square miles of ¼-inch verification survey for approach charts.

77. **Field work.**—The field work was organized as follows :—

*Camp I.—Headquarters at Siwan.*—Camp Officer :—Mr. J. Chatterjee ( Class I ).

Assistant Camp Officers :—Mr. Sukhwant Rai ( Class II ), Mr. S. C. Ghosh ( Surveyor ), Mr. K. L. Chakraborty ( Surveyor ) and Mr. S. L. Behl ( Surveyor ).

The following work was completed by the camp :—

Secondary, double tertiary and tertiary levelling in sheets 63 N, 72 B, C & G in Sāran district of Bihār.

*Camp II.*—Camp Officer :—Mr. M. K. Chatterjee ( Class II ).

Assistant Camp Officer :—Mr. D. P. Chatterjee ( Surveyor ).

The camp completed the survey of landing and approach charts for four airfields namely, Gaya, Bhubaneswar, Dum Dum and Mohanbari in sheets 72 D, H, 73 H, L, 79 B, 83 I, M in Gaya district in Bihār, Puri district in Orissa, 24-Parganas district in West Bengal and Lakhimpur district in Assam.

*Camp III.*—*Headquarters at Charama.*—Camp Officer :—Mr. B. R. Swarup ( Class II ) from 15-11-49 to 20-2-50 ; Mr. M. R. Subramanian ( Surveyor ) from 21-2-50.

Assistant Camp Officer :—Mr. S. N. Setlur ( Surveyor ).

This camp completed the planimetric control for both Upper Mahānadi reservoir and dam site areas and height control for the reservoir area only for complete air survey in sheet 64 H in Bastar and Raipur districts of Madhya Pradesh.

*Camp IV.*—*Headquarters at Melchamunda.*—Camp Officer :—Mr. B. K. Satpathi ( Class II ).

This camp completed stonelaying and tertiary levelling in the commanded area of the Mahānadi ( Hirākud ) project in sheets 64 O, P & 73 C in Sambalpur and Patna districts of Orissa and Sarangarh district of Madhya Pradesh.

78. *Description of Country.*—The country was generally flat with open cultivation and scattered trees.

79. *Health.*—Health in the field was, on the whole, good and there were no casualties.

80. *Recess Duties.*—Recess work was all in connection with the 4-inch mapping of the Mahānadi ( Hirākud ) irrigation area. It was organized as follows :—

*Section I*, under Mr. M. K. Chatterjee ( Class II ), with 2 surveyors, 1 air survey draftsman and 10 draftsmen completed the survey and mapping of 8 irrigation sheets.

*Section II*, under Mr. B. R. Swarup ( Class II ), with 1 surveyor, 1 air survey draftsman and 7 draftsmen completed the survey and mapping of 6 irrigation sheets.

*Section III*, under Mr. K. S. Singh ( Class I ) with 1 surveyor, 1 air survey draftsman and 10 draftsmen completed the survey and mapping of 8 irrigation sheets.

*Section IV*, under Mr. B. K. Satpathi ( Class II ), with 1 surveyor, 1 air survey draftsman and 11 draftsmen completed the survey and mapping of 8 irrigation sheets.

*Section V*, under Mr. M. R. Subramanian ( Surveyor ), with 1 surveyor, 1 air survey draftsman and 10 draftsmen completed the survey and mapping of 4 irrigation sheets.

## No. 12 PARTY

*Officer in charge* :— $\left\{ \begin{array}{l} \text{Mr. J. C. Ross, to 30-8-49.} \\ \text{Mr. N. C. Sen, B.Com. from 31-8-49 to 12-12-49.} \\ \text{Mr. J. C. Berry, from 13-12-49.} \end{array} \right.$

81. *General*.—The party continued air surveys and fair-mapping for various town planning, hydro-electric and other similar projects for geological investigations in Assam, Bengal, Bihār and Orissa. The headquarters of the party remained at Shillong throughout the year.

82. *Personnel*.—The average strength of the party was 1 Class I Officer, 3 Class II Officers, 6 Surveyors, 1 Survey Assistant and 25 other Class III personnel including 4 clerks.

83. *Areas Surveyed*.

86 square miles of 1-inch revision air survey of outline only.

37 square miles of 2-inch air survey of contours on photo-mosaics.

182 square miles of 4-inch revision air survey.

67.8 square miles of 6-inch revision air survey of outline only.

29 square miles of 6-inch revision air survey of contours only.

84. *Field Work*.—The party was not employed on any field work during the year.

85. *Work at Headquarters*.—The party was organized into sections according to the urgency of the work and availability of personnel. It was mainly divided into two sections, although, at one period, there were three sections on productive work and one on training. The officers who held charge of the sections were Messrs. D. Biswas and G. B. Das ( Class IIs ), Messrs. N. K. Basu and T. K. Chatterjee ( Surveyors ) and Mr. P. N. Dutta ( Survey Assistant ).

The following extra-departmental surveys were carried out by the above sections :—

( a ) 86 square miles of 1-inch revision air survey of outline only of the Kāziranga Game Sanctuary in Nowgong and Sibsagar districts of Assam.

( b ) 37 square miles of 2-inch air survey of contours only on a photo-mosaic of the Dihāng Reservoir area in the Abor Hills district, North-East Frontier Agency, Assam.

( c ) 171 square miles of 4-inch revision air survey of the Bokaro Coalfields area in Hazāribāgh district of Bihār.

( d ) 11 square miles of 4-inch revision air survey of the Dungri Lime-stone Deposit area in Sambalpur district of Orissa,



- ( e ) 67·8 square miles of 6-inch revision air survey of outline only for the Calcutta Urban Drainage Scheme.
- ( f ) 9 square miles of 6-inch revision air survey of contours only of the Konār Pipe Line area in Hazāribāgh district of Bihār.
- ( g ) 18 square miles of 6-inch revision air survey of contours only of the Konār Reservoir area in Hazāribāgh district of Bihār.
- ( h ) 2 square miles of 6-inch revision air survey of contours only ( for an appliqué slip to the Konār Pipe Line Extension ) in Hazāribāgh district of Bihār.

In addition to the above work, 1·1 square miles of fair-mapping on the 16-inch scale was carried out of the Bokāro Dam area in Hazāribāgh district of Bihār, as also other work in connection with the preparation of contoured photo-mosaics, scrutiny of photographs, etc.

86. Training.—A training section under Messrs. T. K. Chatterji and M. L. Goswami ( Surveyors ) was formed for a period of five months, from June to October 1949.

The following were trained in air survey :—

- 2 Assistant Geologists from the Geological Survey of India.
- 2 Assistant Engineers from the P.W.D., West Bengal.
- 6 Surveyors.
- 1 Plane-tabler.
- 4 Draftsmen.

The training included compilation and survey of detail from vertical photographs by the Principal Point Radial Line method, determination of heights by parallax measurements and air survey of contours.

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## V. SURVEY REPORTS, SOUTHERN CIRCLE

DIRECTOR :—Mr. H. M. Critchell.

DEPUTY DIRECTOR :— $\left\{ \begin{array}{l} \text{Mr. J. C. Berry, to 13-11-49.} \\ \text{Mr. P. A. Thomas, from 14-11-49.} \end{array} \right.$

87. Summary.—The units administered by the Circle were Nos. 6, 8, 10 and 17 Parties and No. 4 Drawing Office.

In pursuance of orders for disbandment, No. 17 Party closed down its office at Argun Tank Lines, Belgaum on the afternoon of 31st December 1949 and returned to Bangalore. After closing of accounts, disposal of stores and handing over to No. 10 Party at Bangalore, the party was disbanded from 20th March 1950.

### 88. Areas Surveyed.—

- 4,160 square miles of  $\frac{1}{4}$ -inch ground verification survey.
- 1,490 square miles of  $\frac{1}{4}$ -inch ground revision survey.
- 37 square miles of  $1/50,000$  original air survey.
- 160 square miles of  $1/50,000$  ground revision survey.
- 30 square miles of  $1\frac{1}{2}$ -inch ground revision survey.
- 115 square miles of 4-inch original ground survey.
- 360 square miles of 4-inch photo-mosaic contouring.
- 622 square miles of 4-inch original air survey.
- 12.2 square miles of 16-inch original air survey.
- 3.1 square miles of  $1/2,500$  original ground survey.
- 1.3 square miles of 32-inch original ground survey.
- 4 square miles of 32-inch original air survey.
- 6.6 square miles of original ground survey on the scale of 1-inch to 400 feet.
- 2,663 square miles of planimetric and height control for 1-inch original air survey.
- 234 square miles of planimetric and height control for  $1/50,000$  landing charts.
- 1,980 square miles of planimetric and height control for  $1/25,000$  original air survey.
- 552 square miles of planimetric and height control for 4-inch original air survey.
- 320 square miles of planimetric control for 4-inch air survey.
- 660 square miles of height control for 4-inch air survey.
- 820 square miles of triangulation.
- 196 linear miles of double tertiary levelling.

### HEADQUARTERS SECTION

89. General.—The Headquarters Section, under the charge of Mr. M. W. Kalappa (Class I), was employed on air survey and mapping of minor projects and topographical surveys of

the Landing and Approach Charts. In addition to these duties, Mr. M. W. Kalappa carried out the technical supervision of Camp No. 1 of No. 20 ( Cantt. ) Party, employed on cantonment surveys of Dehu Road, Mān Khurd and Trombay in Bombay State. The headquarters of the section remained at Bangalore throughout the year.

90. Personnel.—During recess the strength of the section was 2 Class II officers, 5 Surveyors, 2 Survey Assistants and 21 Plane-tables, Draftsmen and Topographical Trainees, Type 'B'. On completion of the air survey compilation during recess, the strength was reduced for the field season to 1 Class II officer, 4 Surveyors, 1 Temporary Computer, 1 Survey Assistant and 6 Plane-tables, Draftsmen and Topographical Trainees, Type 'B'.

91. Areas Surveyed.—

3,360 square miles of  $\frac{1}{4}$ -inch verification survey for Approach Charts of airfields at Bangalore ( HAL ), Belgaum, Bombay ( Juhu and Santa Cruz ), Madras ( St. Thomas Mount ) and Trichinopoly.

160 square miles of 1/50,000 revision survey for Landing Charts of airfields at Bangalore ( HAL ), Belgaum, Bombay ( Juhu and Santa Cruz ), Madras ( St. Thomas Mount ) and Trichinopoly.

360 square miles of contouring of 4-inch photo-mosaics of Pennār Reservoir.

4.2 square miles of 16-inch original air survey compilation of Pennār Dam site.

4 square miles of 32-inch original air survey compilation of detail and ground verification and contouring of Morvi Town and Environs.

160 square miles of supplementary triangulation for Landing Charts of airfields.

30 square miles of triangulation for 4-inch original air survey of Pej-Ulhās Irrigation Project.

86 linear miles of double tertiary levelling for Landing Charts of airfields.

92. Field Work.—The field work was carried out in isolated areas scattered over Bombay, Madras and Mysore States. Seven detachments were sent out and controlled from Bangalore. Field work was continued from April to June 1949 and again commenced in November 1949.

The following surveys, triangulation and levelling were carried out :—

- (a) Mr. S. Muthukrishnan ( Surveyor ), assisted by 1 Surveyor and 2 Topographical Trainees, Type 'B', completed the ground verification and contouring of 4 square miles of 32-inch original air survey compilation of detail of Morvi Town and Environs

in sheet 41 J in Central Saurāshtra district of Saurāshtra State.

- (b) Mr. S. Ramakrishnan (Surveyor), completed 30 square miles of supplementary triangulation and 1/50,000 revision survey, 540 square miles of  $\frac{1}{4}$ -inch verification survey and 17 linear miles of double tertiary levelling for Landing and Approach Charts of Madras ( St. Thomas Mount ) Airfield in sheets 57 O and P and 66 C and D in Chingleput and Madras districts of Madras State.
- (c) Mr. K. B. K. Menon (Surveyor), completed 30 square miles of supplementary triangulation and 1/50,000 revision survey, 800 square miles of  $\frac{1}{4}$ -inch verification survey and 15 linear miles of double tertiary levelling for Landing and Approach Charts of Trichinopoly Airfield in sheet 58 J in Tanjore and Trichinopoly districts of Madras State.
- (d) Mr. P. G. Balachandran (Surveyor) completed 30 square miles of supplementary triangulation and 1/50,000 revision survey, 800 square miles of  $\frac{1}{4}$ -inch verification survey ( assisted by Mr. Y. D. Hegde, Surveyor ) and 10 linear miles of double tertiary levelling for Landing and Approach Charts of Belgaum Airfield in sheets 47 L and 48 I in Belgaum and Kolhāpur districts of Bombay State.
- (e) Mr. Y. D. Hegde (Surveyor) completed 40 square miles of supplementary triangulation and 1/50,000 revision survey, 420 square miles of  $\frac{1}{4}$ -inch verification survey and 22 linear miles of double tertiary levelling for Landing and Approach Charts of Bombay ( Juhu and Santa Cruz ) Airfields in sheets 47 A, B, E and F in Bombay, Kolāba and Thāna districts of Bombay State.
- (f) Mr. C. M. Azimuddin (Survey Assistant) assisted by Mr. S. Krishnamurti (Temporary Computer) completed 30 square miles of supplementary triangulation and 1/50,000 revision survey, 800 square miles of  $\frac{1}{4}$ -inch verification survey and 12 linear miles of double tertiary levelling for Landing and Approach Charts of Bangalore ( HAL ) Airfield in sheets 57 G and H in Bangalore district of Mysore State and Salem district of Madras State.
- (g) Mr. S. Krishnamurti (Temporary Computer) completed 30 square miles of triangulation for 4-inch original air survey of Pej-Ulhās Irrigation Project in sheets 47 E and F in Kolāba district of Bombay State.
- (h) *Special Field Work*.—A reconnaissance detachment under the charge of Mr. M. W. Kalappa, successfully

completed, in spite of adverse weather conditions during June-July 1949, the reconnaissance and building of 9 triangulation stations, fixed 60 intersected points over an area of 96 square miles in Kandla Port and surrounding area and collected valuable data which helped considerably the planning of survey operations of No. 6 Party during the field season 1949-50 in sheets 41 E and I in Kutch State.

93. *Air Survey Training.*—Topographical Trainees, Type 'B', who were attached to this section, were given intensive training in air survey and were subsequently employed on productive work.

94. *Miscellaneous.*—Health in the field was on the whole fair, except in Bombay City and environs where most of the Class IV personnel suffered from malaria.

The out-turn of revision and verification survey was low as most of the surveyors had very little previous plane-tableing experience. Besides, the specifications for the survey of Landing and Approach Charts of airfields, undertaken by the Department for the first time, differed in some respects from those of normal topographical surveys.

95. *Recess Duties.*—The section was organized into two air survey and mapping sub-sections, one under Mr. C. Sivaraman (Class II) and the other under Mr. P. G. Balachandran (Surveyor). The following jobs of air survey compilation and mapping were completed :—

4.2 square miles of 16-inch air survey compilation of Pennār Dam site in sheet 57 N in Cuddapah and Nellore districts of Madras State.

360 square miles of contouring of 4-inch photo-mosaics of Pennār Reservoir in sheets 57 J and N in Cuddapah district of Madras State.

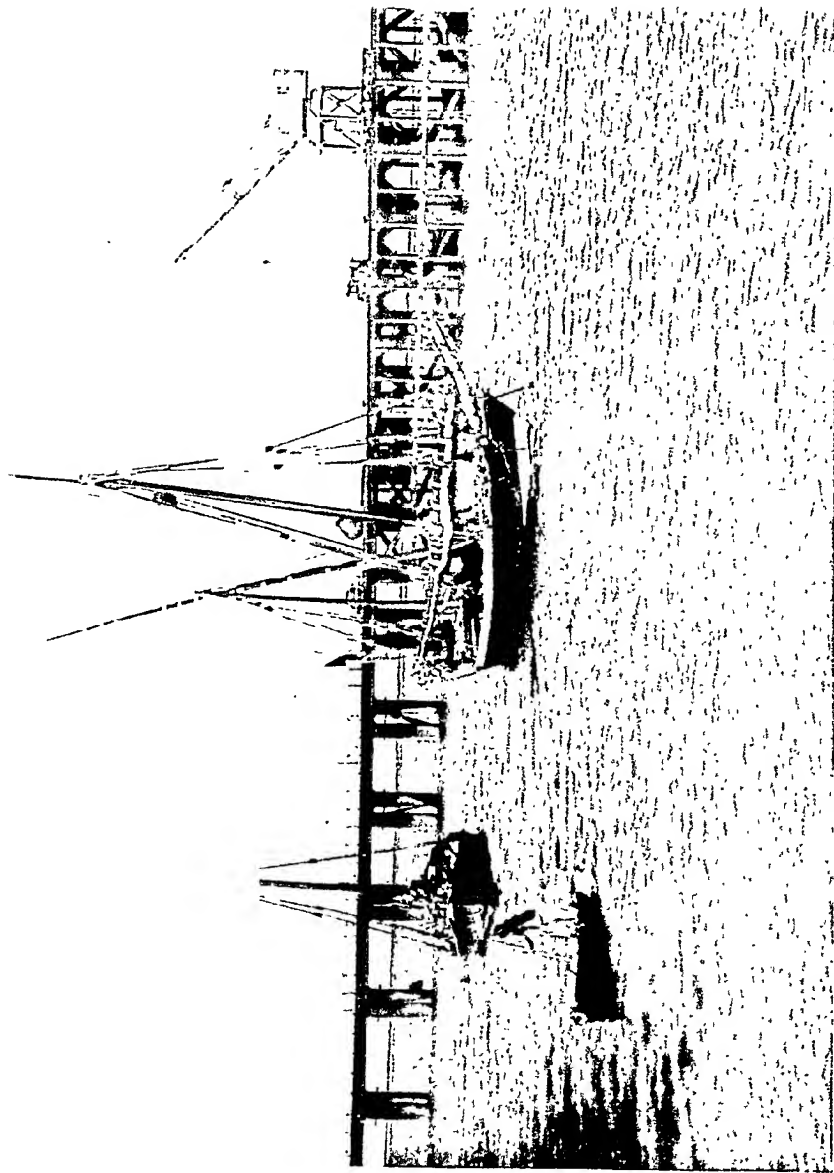
The mapping of 6 sheets of 32-inch survey of Morvi Town and Environs was completed partly during the recess and partly during the field season by the plane-tableers and draftsmen of the section, who remained at headquarters.

### No. 6 PARTY

*Officer in charge :—* { Mr. M. R. Nair, B.A., to 23-11-49.  
                                  { Mr. P. A. Thomas, from 24-11-49.

96. *General.*—The party returned from the field to recess headquarters in Bangalore during May 1949 and was employed on the mapping of the work done during the field season. In late recess the field programme for the ensuing field season was finalized and consisted almost entirely of heavy demands from the Central Waterpower, Irrigation and Navigation Commission, the Director General of Civil Aviation and the Development Commissioner, Kandla Port Development, Kutch. To cope with this heavy

The pier and anchorage at  
KANDLA in KUTCH.  
No. 6 Party has undertaken  
extensive surveys in  
connection with  
development proposals for  
the port of KANDLA.





A planetabler at work at the survey station on the roof of the Customs house at KANDLA Port.

programme of work the party was considerably reinforced by personnel from other units in the Directorate, and, after serious delay due to the late supply of air photographs, took the field in detachments between December and February. An air survey and drawing section and the party headquarters remained at Bangalore.

97. Personnel.—During recess the strength of the party was 1 Class I officer, 2 Class II officers, 7 Surveyors and 30 Plane-tables, Draftsmen, Topographical Trainees and Clerks. Later this strength was increased to 7 Class II officers, 10 Surveyors and 55 Plane-tables, Draftsmen, etc.

98. Areas Surveyed.—

- 870 square miles of 1/250,000 scale revision survey for Approach Chart of Ahmadābād Airfield.
- 37 square miles of original air survey for Landing Chart of Ahmadābād Airfield on 1/50,000 scale.
- 182 square miles of 4-inch original air survey for Kandla Port Development.
- 2,000 acres of 1/2,500 scale original survey of Jāmnagar Airfield.
- 1.3 square miles of original 32-inch ground survey of Dharoi Dam site.
- 6.6 square miles of large scale original survey on 1-inch to 400 feet scale for Kandla Port Development.
- 2,040 square miles of planimetric and height control for future original air survey on 1-inch scale in Kutch State.
- 623 square miles of planimetric and height control and photographic verification for 1-inch original air survey for Kandla Port Development.
- 74 square miles of planimetric and height control and photographic verification for 1/50,000 scale original air survey for Landing Charts of Jāmnagar and Ahmadābād Airfields, 37 square miles each.
- 1,980 square miles of planimetric and height control and verification on photographs, for 1/25,000 scale original air survey for Kandla Port Development, which includes data for original air survey for Landing and Approach Charts of Bhuj ( Rudramada ) Airfield.
- 300 square miles of planimetric and height control for 4-inch original air survey of Kakarpāra Reservoir.
- 40 square miles of planimetric and height control and photographic verification of Dharoi Reservoir on 4-inch scale.
- 182 square miles of planimetric and height control for 4-inch original air survey for Kandla Port Development.
- 820 square miles of triangulation for future survey.



110 linear miles of double tertiary levelling for Dharoi Reservoir.

99. Field Work.—The field work was organized as follows:—

*Camp (1).*—Mr. G. E. Bower (Class II) supervised the work of the following detachments:—

- (a) Dharoi Dam site and reservoir surveys in sheet 45 D in Banās Kāntha and Sābar Kāntha districts of Bombay State under Mr. K. N. S. K. Pillai (Surveyor).
- (b) Ahmadābād Airfield survey in sheets 46 A and B in Ahmadābād, Kaira and Mehsāna districts of Bombay State under Mr. C. Sivaraman (Class II).
- (c) Kakarpāra Reservoir planimetric and height control in sheet 46 G in Surat district of Bombay State under Mr. C. Sivaraman (Class II).
- (d) Triangulation for future surveys in sheets 46 G and H in Dāngs, Nāsik, Surat and West Khāndesh districts of Bombay State.

*Camp (2).*—Mr. J. E. David (Class II) after doing initial personal triangulation and supervising the triangulation of 6 other surveyors to provide control for 4-inch, 1/25,000, and 1-inch scales air surveys for Kandla Port Development in sheets 41 E, F, I and J in Kutch State, supervised the ground verification work on air photographs for 20 sheets on 1/25,000 and 4 sheets on 4-inch scales of above areas.

*Camp (3).*—Mr. M. N. Kutty (Class II) supervised the ground verification work on air photographs for 23 sheets on 1/25,000 scale for Kandla Port Development of the above area in Kutch State.

*Camp (4).*—Three surveyors extended the triangulation done by them for Kandla Port Development in order to complete to edge the 14 one-inch sheets surrounding the Kandla area in sheets 41 E, F, I and J in Kutch State.

100. Description of Country.—The bulk of the party programme lay in Kutch State, which is on the whole treeless, barren and rocky but varied by ranges of hills and isolated peaks. In the south west there are a few well tilled valleys and tracts of rich pasture land. In the east is the salt waste of the Little Rann and in the south an extensive foreshore of tidal creeks and mangrove swamps. The whole territory of Kutch is almost entirely cut off from the continent of India—north by the Great Rann, east by the Little Rann and south by the Gulf of Kutch.

101. Miscellaneous.—The health of the party was, on the whole, good, though some indisposition was caused by the brackish water available. The death by electrocution is recorded with regret of one Class IV servant while on helio duty in Kutch State.

While on triangulation in the Gulf of Kutch the rowing boat in which Mr. K. N. S. K. Pillai (Surveyor), was proceeding to work

capsized and all instruments and records were lost. Divers succeeded in recovering only the plane-table stand. No lives were lost.

The Marine Survey of India while carrying out their hydrographic triangulation for the port of Kandla established connection at several points with the topographical stations of the triangulation of this unit. This is the first time that Marine Survey triangulation has been in the same terms as the Indian triangulation system and is the result of close co-operation between the two departments.

102. Recess Duties.—Two primary mapping sections under Messrs. G. E. Bower (Class II) and B. S. Chopra (Surveyor) were engaged on the fair mapping of the 18 one-inch sheets surveyed during the previous field season. A third section under Mr. P. Ramamoorthy (Class II) was engaged on the mapping of the Ukai Dam site and Moj Commanded areas. A computation section consisting of two surveyors was engaged on computations.

#### No. 8 PARTY

Officer in charge :— $\left\{ \begin{array}{l} \text{Mr. P. S. Shinghal, C.E., to 26-6-49.} \\ \text{Mr. B. B. Kuttappa, from 27-6-49 to 29-7-49.} \\ \text{Mr. F. M. Hawley, from 30-7-49.} \end{array} \right.$

103. General.—The party continued to be engaged mainly in the survey and mapping of the area of the Tungabhadra Project for the Hyderabad Government.

In addition, it completed the 16-inch air survey and mapping of the Kistna Dam site, during the recess season, for the Madras Government.

During the field season the following new jobs were undertaken:—

(a) The ground control for a contoured air-photo mosaic of the Kistna Reservoir on the 4-inch scale for the Madras Government. This job is expected to be completed by the end of 1950.

(b) Quarter-inch ground verification survey for the Approach Chart on the same scale and  $1\frac{1}{2}$ -inch ground revision survey for the 1/50,000 scale Landing Chart of the Begampet Airfield in accordance with the specifications laid down by the International Civil Aviation Organization. These surveys were completed subject to revision subsequently, as the airfield was found to be under reconstruction.

104. Personnel.—The average strength of the party during the year was 1 Class I officer, 2 Class II officers, 5 Surveyors, 25 other technical Class III personnel, 3 Clerks, 1 Store-keeper and 1 M.T. Driver.

105. Areas Surveyed.—

800 square miles of ground verification survey on  $\frac{1}{4}$ -inch scale.

- 30 square miles of ground revision survey on  $1\frac{1}{2}$ -inch scale.
- 115 square miles of original plane-table contouring on 4-inch scale in Tungabhadra Project area.
- 440 square miles of original air survey of Tungabhadra Commanded area on 4-inch scale.
- 8 square miles of 16-inch original air survey of Kistna Dam site.
- 320 square miles of planimetric control ( triangulation and traverse ).
- 435 square miles of height control ( double and single tertiary levelling ) for Tungabhadra Commanded area.
- 225 square miles of height control ( double and single tertiary levelling ) for Kistna Reservoir area.

106. **Field Work.**—The field work was organized as follows :—

*Camp ( 1 ).*—Mr. S. R. M. Louis ( Class II ) assisted by Mr. R. S. Ramamoorthy ( Surveyor ) completed 320 square miles of triangulation and double tertiary levelling in the western extension of the Tungabhadra Project, in sheets 56 D and H and 57 A, comprising a strip of land averaging 4 miles in width and extending in an arc from Raichur to Gangāwati in Hyderābād State. In addition, Mr. S. R. M. Louis was in charge of the undermentioned 2 sub-camps :—

*Sub-Camp A.*—Mr. B. N. S. Rao ( Surveyor ) with an average of 2 Class III personnel completed 115 square miles of tertiary levelling, followed by ground contouring of the same area in sheets 56 H and L and 57 E and I near Gadwāl in Hyderābād State.

*Sub-Camp B.*—Mr. M. C. K. V. Raja ( Surveyor ) with 7 other Class III personnel completed 320 square miles of stone laying, resection and tertiary levelling in the western extension of the Tungabhadra Project described above.

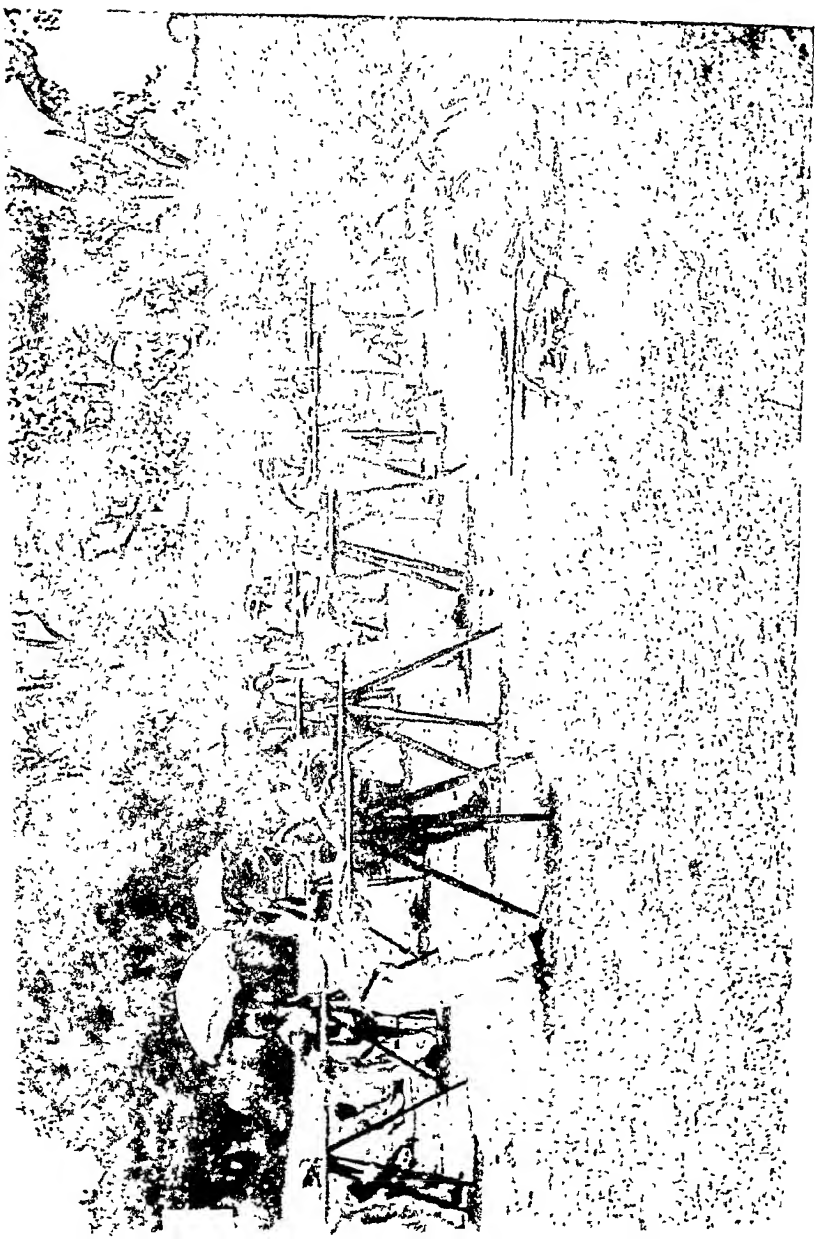
*Camp ( 2 ).*—Mr. J. S. Moorthy ( Surveyor ) assisted by 4 other Class III personnel completed 225 square miles of height control by tertiary levelling in the area of the Kistna Reservoir, in sheets 56 H and L and 57 E and I situated below the confluence of the Kistna and Tungabhadra Rivers on the border of Hyderābād and Madras States.

*Airfield Detachment.*—Mr. R. S. Ramamoorthy ( Surveyor ) assisted by Mr. J. D. Satyanadhan ( Plane-tabler ), completed 800 square miles of ground verification survey on the  $\frac{1}{4}$ -inch scale and 30 square miles of ground revision survey on the  $1\frac{1}{2}$ -inch scale in sheet 56 K of Hyderābād ( Begampet ) Airfield in Hyderābād State.

107. **Description of Country.**—The country, in which the survey for the Tungabhadra Commanded Area was carried out, is an open and gently undulating plain mostly of black cotton soil under



A party of trainees  
under instruction  
in planetable  
surveying in  
No. 10 Party.



cultivation of cotton and *jawār*. Numerous isolated rocky hills rising up to 300 feet with rock and stone outcrops abound.

The greater part of the country in the Kistna Reservoir area is an open flat plain mostly under paddy cultivation.

108. Recess Work.—The party was organized for recess into 2 main sections as follows :—

One drawing section.

One computing and miscellaneous section.

The drawing section under Mr. B. B. Kuttappa ( Class I ), carried out 4-inch air survey and mapping ( detail and contouring ) of 19 sheets of the Tungabhadra Project and 16-inch air survey and mapping ( detail and contouring ) of 2 sheets of the Kistna Dam site. This drawing section, reduced in strength, continued air survey and mapping at the party headquarters during the field season.

The computing and miscellaneous section, under Mr. J. E. David ( Class II ) and later under Mr. S. R. M. Louis ( Class II ), completed the computations of triangulation, traversing and levelling carried out during the previous field season.

#### No. 10 PARTY

*Officer in charge :—*Mr. B. N. Murthy, B.Sc.

109. General.—The party continued its function as a training party for Topographical Trainees, Type 'B', Class III service.

The number of trainees was 68 during the recess season. The number increased to 95 during the field season with the transfer of 27 trainees from No. 17 Party on its disbandment.

The headquarters of the party remained at Bangalore throughout the year.

110. Personnel.—The average strength of the party consisted of 1 Class I officer, 3 Class II officers, 2 Surveyors, 8 Plane-tablers as Instructors, 82 Topographical Trainees Type 'B', 3 Clerks, 1 Store-keeper and 1 M.T. Driver.

111. Training.—Training during recess 1949 was carried out in and around Bangalore in air survey, theodolite traversing and tertiary levelling. Fair mapping formed a part of a training-cum-productive drawing scheme. The productive drawing of 6 one-inch standard sheets on the scale of  $1\frac{1}{2}$ -inches to 1 mile, surveyed by No. 6 Party during 1947-48 and 1948-49 field seasons, was carried out by 12 Topographical Trainees, Type 'B', under the supervision of Mr. M. A. Azim ( Surveyor ), as section officer, assisted by 2 Survey Assistants.

Training in the field was carried out in the area lying between Nandi and Tondabhāvi villages in the Kolār district of Mysore State, about 40 miles north of Bangalore. The training consisted of plane-tabling on the scales of 1/25,000 and 1/63,360. The trainees were grouped in three camps under Mr. M. A. Azim ( Surveyor ), and Messrs. R. Doraiswamy and M. G. Mohiuddin

(Survey Assistants), each assisted by 3 instructors. The training was controlled from Bangalore.

The present batch of trainees will be completing the scheduled training as described in Appendix to Technical Notes of Technical Report 1948-49 by October 1950 and will be posted to different Circles for productive work.

The trainees, as a whole, showed great keenness in their training and the progress achieved was above the average.

### No. 17 PARTY

*Officer in charge* :—Mr. J. A. Cabral (Current duties).

112. General.—The party continued to function as a training party till disbanded on 20th March 1950.

With the formation of Western Circle in view, it was decided to move the party headquarters to the area of the future Western Circle, and the party headquarters actually moved from Bangalore to Belgaum on 25th April 1949. The party had nearly completed the recess work and was preparing to take the field, when as a measure of economy, orders were issued for its disbandment. Preparation for the field was stopped and the disbandment of the party and dispersal of personnel was carried out as follows :—

(a) 1 Class II officer, 2 Surveyors and 3 Plane-tables were transferred to various parties in the Circle during November 1949.

(b) A batch of 13 Topographical Trainees, Type 'B' (1946 batch) with one clerk was transferred to Northern Circle and a batch of 13 Topographical Trainees, Type 'B' (1946 batch) was transferred to Eastern Circle in December 1949.

(c) The remainder of the party, consisting of 1 Class II officer 1 Surveyor, 3 Plane-tables, 27 Topographical Trainees, Type 'B' (1948 batch), 2 Clerks and 1 Store-keeper, returned to Bangalore from Belgaum in January 1950 with all the stores and records of the party after finally closing the party headquarters at Belgaum.

(d) On arrival at Bangalore, 3 Plane-tables, 27 Topographical Trainees, Type 'B' and 1 Clerk were transferred to various units of the Circle.

(e) The closing of accounts and disposal of stores of the party were carried out by 1 Class II officer assisted by 1 Clerk and 1 Store-keeper and stores and records were finally handed over to No. 10 Party on 20th March 1950 from which date the party ceased to exist. The remaining personnel were absorbed in the units of the Circle.

113. Personnel.—The average strength of the party before disbandment was 2 Class II officers, 3 Surveyors, 6 Plane-tables, 53 Topographical Trainees, Type 'B', 3 Clerks and 1 Store-keeper.

114. Field Work.—There was no field programme as the disbandment of the party was decided on and carried out during the field season as stated above.

115. Recess Duties.—Training during recess 1949 was carried out in Belgaum according to the schedule given in Appendix to Technical Notes of Technical Report of 1948-49. The course of out-door work in traversing and levelling could not, however, be completed owing to bad weather conditions.

Some promising senior trainees ( 1946 batch ) were employed on productive fair drawing. Two sections, one under Mr. M. N. Kutty ( Class II ) and the other under Mr. Y. D. Hegde ( Surveyor ) each consisting of 3 senior Plane-tablers who carried out supervisory duties as well as drawing and 5 senior trainees, carried out productive fair drawing of 4 one-inch sheets, surveyed by them during the previous field season.



## PART II.—MAP PUBLICATION AND OFFICE WORK

### VI. INTRODUCTION

116. Progress of Map Publication.—*Indexes D to F* at the end of this report, show the progress of publication to date for all standard series of modern maps, excluding those maps which are classified "Restricted", and not available for issue to the public.

117. Work of Map Drawing and Printing Offices.—The work of the drawing and printing offices of the Department for the period under report is described in three sections of Part II of this report, as follows :—

*Section VIII* ( page 50 ) gives statistics of map publications, extra-departmental printing and map issues.

*Section IX* ( page 55 ) describes the work of the drawing offices and includes two tables which quantitatively summarize this work.

*Section X* ( page 58 ) describes the work of the printing offices.

118. Map Publication Policy.—The period under review saw the change over from a policy of centralized planning of mapping to that of decentralization in so far as topographical mapping was concerned, to the Regional Directors. The centralized planning was introduced during World War II as the whole of our survey resources of mapping and printing were devoted to the needs of the Defence Services. After the war this policy had to continue for sometime to enable us to build up our depleted stocks of maps for civil issue. This policy is not suitable for peace time conditions, and the decentralization of topographical mapping to Regional Directors was necessary to enable the Directors to consult local authorities and look after the mapping requirements of the areas for which they are responsible. Thus the Map Publication Directorate, as regards actual mapping, only retains the responsibility for geographical mapping and for our international mapping commitments, such as the International Civil Aviation Organization Charts.

During this period also the whole of our geographical mapping policy was reviewed, and the maintenance of maps on certain scales considered redundant was suspended. The Department will now maintain a series of geographical maps on graduated series of scales from 1/M up to 250 miles to 1 inch.

We have also during the period under report reverted to a full colour specification for all our new topographical maps. All new editions which show the boundaries of our new political set up are to be printed in these colours. For reissues required in

areas where information regarding the new boundaries is not available, maps will retain their old specifications.

The necessity of referring to local governments about the boundaries of the new political divisions, where these have been changed under the New Constitution, has slowed down the progress of our quarter-inch mapping.

There has been a growing demand for up-to-date State maps showing district boundaries, but owing to the fact that, until very recently, there was a ban on the showing of the Indo-Pakistan Boundary on maps on scales larger than 50 miles to 1 inch, little progress could be made on such State maps as were affected by this ban. In other cases we have also been held up by lack of precise information as to the new political divisions. However, progress is now being made to meet this want.

To meet the immediate demands for a map showing the new political set up, we produced the first edition of the 70-mile Political map in February 1950. It is hoped in due course to produce a Hindi Edition of this map; the printing of this depends, however, on when we receive Government of India's approval to the spelling of the names in the Devanagiri script.

The new 40-mile map of India is nearing completion, and it is hoped that this will be printed off in January 1951. A new Road map on the same scale is also expected to be printed shortly afterwards.

Mapping of the military series, HIND 5014, for the Army, by the newly formed Army Drawing Section, which is at present located in No. 1 Drawing Office, has been proceeding steadily.

Besides these departmental jobs, a lot of publication work for the Central Water power, Irrigation and Navigation Commission in connection with the various Development Projects has been undertaken. We have also been doing a lot of commercial work both for Government Departments and private firms.

## VII. PERSONNEL OF THE MAP PUBLICATION DIRECTORATE AND OF HEADQUARTERS OFFICES EMPLOYED ON MAP DRAWING AND PRINTING

### PERSONNEL

#### Dehra Dun. Director, Map Publication

Lt.-Col. J. S. Paintal, R.I.E., to 21-8-49.

Colonel I. H. R. Wilson, from 22-8-49.

#### Deputy Director, Map Publi- cation

Lt.-Col. J. S. Paintal, R.I.E., to 3-9-49.

Colonel I. H. R. Wilson, from 4-9-49 to 21-11-49 and from 19-1-50 to 19-2-50.

Mr. K. L. Dhawan, from 22-11-49 to 18-1-50 and from 20-2-50.

#### Assistant Director, Map Publi- cation

Mr. R. L. Ghei (current duties), to 10-9-49.

„ C. T. Hurley, from 11-9-49 to 12-12-49.

„ N. D. Joshi, from 13-12-49.

#### No. 1 Drawing Office

#### Officer in charge—

Mr. A. K. Sen Gupta (Sr.), to 18-8-49,

„ C. T. Hurley, from 19-8-49.

*Deputy Superintending Surveyor—*

Mr. G. C. Aggarwala.

*Officer Surveyors—*

Mr. J. N. Kohli.  
 „ N. N. Dhawan.  
 „ A. C. Maulick.  
 „ R. B. Lal.  
 „ I. C. Dev.  
 „ K. Venkataraman.

*Surveyors—*

Mr. N. C. Roy, to 27-3-50.  
 „ J. R. Chibbar.  
 „ P. C. Malik.  
 „ B. F. Ghildyal.

*Photo-Litho Office (Hathibarkala)**Manager—*

Mr. K. L. Dev, to 14-4-49.  
 „ P. N. Kirpal, to 10-6-49.  
 „ C. V. M. Hayman, from 11-6-49.

*Asst. Manager—*

Mr. P. K. Gupta to 28-2-50.  
 „ Bhagat Singh, from 1-3-50.  
 „ S. Michael ( Offg. ), from 30-5-49.

*Photo-Zinco Office**Manager—*

Mr. Bhagat Singh ( current duties ), from  
 15-4-49 to 10-7-49.  
 „ P. N. Kirpal, from 11-7-49.

*Asst. Manager—*

Mr. Bhagat Singh, to 28-2-50.  
 „ P. K. Gupta from 1-3-50.

*Map Record and Issue Office**Officer in charge—*

Mr. N. C. Nath.

*Works Office (Hathibarkala)**Electrical Engineer—*Mr. A. L. Sood.*Asst. Cost Accounts Officer ( Temporary )*

Mr. S. C. Dey, from 3-1-50.

*Stores Office, Survey of India**Stores Officer—*

Mr. N. T. Wadhvani, to 28-2-50 ( Post  
 abolished, from 1-3-50 ).

*Dy. Stores Officer—*

Mr. C. G. Gehani,

*Asst. Stores Officer—*

Mr. Gurcharan Singh.

„ H. L. Tejwani, to 28-2-50 ( Post  
 abolished, from 1-3-50 ).

*Shillong. Director, Eastern  
Circle*

Colonel R. T. L. Rogers.

*Attached to Headquarters Office  
( Shillong )**Officer Surveyor—*Mr. N. C. Sen.*Surveyor—*Mr. A. K. Maitra, from 13-3-50.*Calcutta. Deputy Director,  
Eastern Circle*

Mr. M. M. Ganapathy, to 31-8-49 and from  
 29-10-49.

„ J. C. Ross, from 1-9-49 to 28-10-49.

*No. 5 Drawing Office**Officer in charge—*

Mr. L. J. Bagnall.

*Officer Surveyor—*

Mr. P. C. Sengupta, to 5-11-49 and from  
 28-11-49.

„ A. K. Talapatra.

*Surveyor—*

Mr. N. C. Naug, to 28-11-49.

„ L. R. Howard.

„ S. K. Guha.

„ N. C. Roy, from 28-3-50.

*Photo-Litho Office**Manager—*

Mr. C. V. M. Hayman, to 2-6-49.

„ K. L. Dev, from 3-6-49.

*Asst. Manager—*

Mr. G. A. H. Thomas.

*Map Record and Issue Office**Non-executive charge—*

Mr. A. K. Talapatra, to 25-10-49 and  
 from 11-12-49 to 2-1-50.

„ K. B. Muthana, from 26-10-49 to  
 10-12-49 and from 3-1-50.

*Engraving Office**Head Engraver—*

Mr. A. R. J. Dalziel, to 15-8-49.

*Asst. Head Engraver—*

Mr. Parimal Dasgupta,

Dehra Dūn. Director, Northern  
Circle

Bangalore. Director, Southern  
Circle

Mr. B. N. Saha, to 3-9-49 and from 21-11-49.  
Lt.-Col. J. S. Paintal, R.I.E., from 4-9-49  
to 20-11-49.

Mr. H. M. Critchell.

*No. 2 Drawing Office*

*Officer in charge—*

Mr. N. D. Joshi, to 14-11-49.  
„ C. P. E. Davenport, from 15-11-49.

*Surveyors—*

Mr. M. L. Kohli.  
„ S. B. P. Mathur.  
„ Jagan Nath.  
„ P. R. S. Nayar.  
„ Mastan Singh.  
„ Gurcharan Singh.  
„ R. C. Sachdev, from 8-4-49.

*Letterpress Printing Section*

( Under Director, Geodetic and Training  
Circle )

Mr. H. H. Williams, to 12-6-49 and from  
13-9-49.  
„ K. P. Bhattacharji, from 13-6-49 to  
12-9-49.

*No. 4 Drawing Office*

*Officer in charge—*

Mr. J. C. Berry, to 25-11-49.  
„ M. W. Kalappa, from 26-11-49 to  
23-2-50.  
„ M. R. Nair, from 24-2-50.

*Officer Surveyors—*

Mr. M. W. Kalappa.  
„ K. B. Muthana, to 12-10-49.  
„ C. Sivaraman, to 31-10-49.

*Surveyors—*

Mr. N. M. Bopaiiah.  
„ H. C. Deva.  
„ H. N. Murti Rao, to 31-8-49.  
„ P. G. Balachandra Menon.  
„ S. Muthukrishnan, to 7-9-49.  
„ S. Krishnamurthy, from 3-11-49.  
„ A. Ramachandran, to 31-8-49.  
„ S. Ramakrishnan.  
„ D. D. Mehta, to 9-8-49.  
„ A. Karunakaran, to 31-8-49.  
„ K. B. K. Menon, from 18-8-49.  
„ Y. D. Hegde, from 1-11-49.

## VIII. PUBLICATIONS, EXTRA-DEPARTMENTAL PRINTING AND MAP ISSUES

119. Publications and Extra-departmental Printing.—The publications of the Department during the period and printing done for other Government Departments and for the public are summarized in the following tables :

Table I ( *a* ) Departmental maps.

Table I ( *b* ) Extra-departmental maps.

Table I ( *c* ) Litho-printing, other than maps.

The progress made up to the end of the period under report in publication of the main series of topographical and geographical maps produced by the Department is given in Table II. Table III shows the letterpress publications for the period.

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Class of Maps	Copies printed		Value Rupees		
	A	TOTAL	DEHRA DUN	CALCUTTA	TOTAL
			Map Pub- lication Office	Eastern Circle	
<b><u>PRINTED FOR THE DEFENCE FORCES</u></b>					
Geographical Maps					
Asia HIND 5000 Series ..		4,200	12,600		12,600
Asia HIND 5002 Series ..	20	22,020	..	8,258	8,258
India HIND 5014 Series ..	49	25,449		9,543	9,543
Special Maps					
Manœuvre and Radius Maps ..	00	3,900	..	6,826	6,826
Cantonment Maps ..	..	1,358	2,716	..	2,716
Miscellaneous Maps..	..	22,300	8,363	..	8,363
Total ..	00	79,227	23,679	24,627	48,306
<b><u>PRINTED FOR OTHER DEPARTMENTS OF THE CENTRAL AND STATE GOVERNMENTS</u></b>					
Maps for Irrigation, Hydro-electric and other projects ..	30	39,770	8,494	37,981	46,475
Do. Do. ..	..	..	..	..	..
Do. Do. ..	79	13,379	..	16,704	16,704
Forest Maps ..	..	4,471	11,008	..	11,008
Miscellaneous Maps, Plans, Charts and Diagrams ..	55	12,75,501	31,610	79,230	1,10,840
Total ..	64	13,33,121	51,112	1,33,915	1,85,027
<b><u>PRINTED FOR COMMER- CIAL FIRMS AND THE PUBLIC</u></b>					
Miscellaneous Maps, Plans, Charts and Diagrams ..	52	3,99,682	26,213	59,053	85,266
Total ..	52	3,99,682	26,213	59,053	85,266
GRAND TOTAL ..	85	18,12,030	1,01,004	2,17,595	3,18,599





Class of Maps	Printed	Value Rupees			
	TOTAL	DELHI DUN	CALCUTTA	TOTAL	
		Map Pub- lication Office	Eastern Circle		
<u>DEPARTMENTAL WORK</u>					
Posters .. ..	..	..	..	..	
Booklets .. ..	3,558	1,722	..	1,722	
Miscellaneous ..	92,965	41,342	2,612	43,954	
Total	96,523	43,064	2,612	45,676	
<u>EXTRA-DEPARTMENTAL WORK FOR OTHER CENTRAL AND STATE GOVERNMENT DEPARTMENTS</u>					
Posters .. ..	1,39,038	59,188	..	59,188	
Booklets .. ..	55,341	1,04,481	..	1,04,481	
Miscellaneous ..	1,30,15,267	1,45,746	24,767	1,80,513	
Total	1,32,09,646	3,09,415	31,767	3,44,182	
<u>EXTRA-DEPARTMENTAL WORK FOR COMMERCIAL FIRMS AND THE PUBLIC</u>					
Posters .. ..	2,56,108	1,619	1,233	2,852	
Booklets .. ..	..	..	..	..	
Miscellaneous ..	2,96,033	1,130	18,632	19,762	
Total	5,52,741	2,749	19,865	22,614	
GRAND TOTAL	1,37,62,387	3,12,164	54,632	3,60,796	



Table II—Progress in Publication of Modern Topographical and Geographical Maps

	INDIA			INDIA AND ADJACENT TERRITORIES			
				1/M		1/2M	
	1"=1 Mile	1"=2 Miles	1"=4 Miles	Carte Internationale du Monde	International Civil Aviation Organization Maps	State Maps	Southern Asia Series
Maps Published							
Primary ..	2,890	255	24				..
Compiled ..	..	..	285	33		16	15
Remaining (Approx.)							
Primary ..	485	35	6			..	..
Compiled ..	..	..	56	..	23	..	5
Total (Approx.)	3,375	290	371	33	23	16	20

Note :—(1) In the Carte Internationale du Monde series are also included those sheets of the modified international style on 1/M scale which have been published for the defence services and aviation but which have not as yet been issued in regular international style.

(2) The numbers of sheets remaining for completion are calculated on the total areas covering India shown in the indexes relevant to each series given in the Survey of India map catalogue.

Table III—Letterpress Publications

(a) PUBLISHED AT DEHRA DUN

1. Grid Data Triangulation Pamphlets ( 6 Pamphlets ).
2. Tide-Tables for the Port of Bombay 1950.
3. Tide-Tables for the Port of Rangoon 1950.
4. Tide-Tables, Indian Ocean 1950.
5. Tide-Tables for the Hooghly River 1950.
6. Auxiliary Tables, Part II, 6th Edition.
7. Auxiliary Tables, Part III, 7th Edition.
8. Levelling of Precision, Pamphlets Nos. 55, 65 and 73.
9. General Report 1947.
10. Technical Report 1947.
11. Star Almanac 1950, Part I.
12. Indian Forester for January, February and March 1950.
13. Historical Records of the Survey of India, Vol. II.

Table III—( *concl'd.* )( *b* ) IN HAND AT DEHRA DUN

1. Handbook of Topography, Chapter I.
2. Tide-Tables, Indian Ocean 1951.
3. Tide-Tables for the Port of Bombay 1951.
4. Tide-Tables for the Port of Rangoon 1951.
5. Levelling of Precision, Pamphlet No. 74.
6. Technical Report 1948-49.
7. General Report 1948-49.
8. Annotated Glossary of Survey of India War Records ( 1939-46 ).
9. Secondary Levelling Pamphlet No. 55.
10. Historical Records of the Survey of India, Vol. III.
11. Grid Data Triangulation Pamphlet ( one Pamphlet ).
12. Field Traverse Tables.
13. Indian Forester for April 1950.
14. *The Silviculture Research Code, Vol. III.*

( *a* ) PUBLISHED AT CALCUTTA

1. Agmark Labels.
2. Calcutta and Howrah Guide map ( Booklet ).
3. Calcutta and Howrah Guide map ( Label ).
4. Outdoor Tickets.
5. Departmental Forms :—  
O. 95 ; O. 134 ; O. 164 ; O. 167 ; O. 168.
6. Miscellaneous work for Departmental use :—  
Letter heads, Ledger forms, etc.

( *b* ) IN HAND AT CALCUTTA

1. Agmark Labels, June 1950.
2. Rubber stamps.
3. Miscellaneous Departmental Forms.

## Outturn of Letterpress Printing Sections

Sections	Items or pages published	Copies printed	Impressions pulled
Dehra Dūn ..	1,153	29,67,726	23,95,885
Calcutta ..	460	5,68,226	6,59,486
TOTAL ..	1,613	26,35,952	30,55,371

120. Map Issues.—The issues of both departmental and extra-departmental maps during the period under report by the various Survey of India offices are shown in Table IV below. Table V, which follows, gives the stocks of maps held on 31st March 1950, of both departmental and extra-departmental maps normally stocked for sale.

Table IV—Maps issued

	CENTRAL AND STATE GOVERNMENT DEPARTMENTS		DEFENCE FORCES		PUBLIC		TOTAL		FREE ISSUES	
	Number of copies	Sale Value Rupees	Number of copies	Sale Value Rupees	Number of copies	Sale Value Rupees	Number of copies	Sale Value Rupees	Number of copies	Sale Value Rupees
<b>DEPARTMENTAL</b>										
Dehra Dun ..	50,980	61,081	7,20,330	2,70,934	38,299	50,314	8,15,615	3,82,339	831	848
Calcutta ..	17,808	19,741	2,44,915	19,854	16,064	20,228	2,78,817	1,31,853	9,666	10,101
Shillong ..	930	1,055	..	..	304	376	1,234	1,431	1,036	1,095
Bangalore ..	1,405	1,405	..	..	3,331	3,334	4,736	4,739	1,036	1,039
Delhi ..	4,430	5,353	..	..	4,342	6,193	8,772	11,554	9	25
Total (Departmental) ..	81,559	88,638	9,65,275	3,62,788	62,340	80,450	11,09,174	5,31,876	12,578	13,108
<b>EXTRA-DEPARTMENTAL</b>										
Dehra Dun ..	1,23,95,374	3,79,308	369	139	5,55,432	1,13,212	1,29,51,175	4,02,059	1	1
Calcutta ..	13,52,904	1,50,098	35,744	13,401	1,40,728	34,838	15,35,376	1,98,340	7,945	8,314
Shillong ..	5	10	..	..	..	..	5	10	..	..
Bangalore ..	..	..	..	..	..	..	..	..	..	..
Delhi ..	..	1,872	..	..	621	2,980	1,552	4,858	4	8
Total (Extra-departmental)	1,37,49,214	5,31,288	36,113	13,543	7,02,781	1,51,036	1,44,88,108	6,95,807	7,950	8,323
GRAND TOTAL ..	1,38,30,773	6,19,926	10,01,388	3,76,331	7,65,121	2,31,486	1,55,97,282	12,27,743	20,528	21,431

Note:—Total mounting charges during the period Rs. 57,574.

( This table gives the maps of which stocks are held for sale )

		DELHI		TOTAL	
	PRICE	MAP SALES OFFICE			
	Rs.	Number of copies in stock	Present Face Value Rs.	Number of copies in stock	Present Face Value Rs.
<b>DEPARTMENTAL MAPS</b>					
1/2 M Southern Asia Series ..	30	.	.	9,366	15,732
1/M Carte Internationale du Monde	8	.	.	20,776	57,669
1/M International Civil Aviation Orga tion Series .. ..	..	..	..	.	..
1/M India and Adjacent Countries Series				7,684	12,846
Quarter-inch topographical maps	10	11,252	13,285	3,33,455	3,88,893
Half-inch topographical maps ( Pri and Compiled ) .. ..	19	17,159	19,257	3,87,856	4,05,868
One-inch topographical maps ..	19	61,870	65,163	24,61,048	24,73,589
General maps of India ..	18	786	1,289	14,467	24,525
Maps of States .. ..	15	363	1,008	8,725	24,435
City and Town Guide Maps ..	11	764	2,125	29,543	73,211
Miscellaneous maps, charts and diagram	3	249	315	19,436	17,961
<b>EXTRA-DEPARTMENTAL MAPS STOCKED FOR SALE</b>					
1/2 M Extension of Southern Asia Series ( HIND 1050 Series ) ..	8	367	534	8,406	10,912
1/M ( Army/Air Style HIND 5000 Series	4	2,131	6,393	44,986	1,34,958
Cantonment plans .. ..	8	..	..	48,755	97,995
Forest maps .. ..	..	..	..	1,59,980	2,99,273
Manoeuvre and Radius maps ..	5	174	352	11,471	21,651
Miscellaneous maps, charts and diagram		..	..	..	..

\* This series has been abandoned



Table VI—

(a) denotes work completed and

	TOPOGRAPHICAL						MISCELLANEOUS					
	1/25,000		1-inch		1/2-in Indexes		Charts		Various		Total Man-day's work in year under report	
	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)		(c)
MAP PUBLICATION OFFICE												
No. 1 Drawing Office ..	..	..	..	..	..	47	8	2	..	15	2	7,957
NORTHERN CIRCLE												
No. 2 Drawing Office ..	..	..	..	..	..	..	..	..	..	..	..	..
Field Parties ..	..	..	..	..	..	..	..	..	..	..	..	..
EASTERN CIRCLE												
No. 5 Drawing Office ..	..	..	..	3	..	3	..	..	..	8	6	2,027
Engraving Office ..	..	..	..	..	..	..	..	..	..	32	8	3,877
Field Parties ..	..	..	..	..	..	..	..	..	..	..	..	..
SOUTHERN CIRCLE												
No. 4 Drawing Office ..	..	..	..	11	..	..	..	..	..	..	..	1,447
Field Parties ..	..	..	..	20	..	..	..	..	..	..	..	4
TOTAL ..	..	..	..	34	..	50	8					

## IX. WORK OF DRAWING OFFICES

121. No. 1 Drawing Office, Dehra Dūn.—As a result of the decentralization of mapping responsibilities of topographical maps, No. 1 Drawing Office steadily assumed its primary duties of producing geographical and aeronautical maps of India. The Forest Map Office, which was abolished as such during 1947 and formed a section of No. 2 Drawing Office, was also transferred to No. 1 Drawing Office with effect from the 1st November 1949.

( a ) The main activities of this office were as follows :—

( i ) *Aeronautical Chart Section.*—About 15 draftsmen were employed on the preparation of International Civil Aviation Organization 1:1,000,000 scale World Aeronautical Charts covering India. Three charts were submitted for publication and are expected to be printed off during 1950-51.

About 5 draftsmen were engaged on the preparation of Approach and Landing Charts of the principal Air-ports of India. All these charts were drawn in accordance with the specifications laid down by the Map Division of the International Civil Aviation Organization.

( ii ) *Geographical Section.*—This section of 12 draftsmen was employed on preparing our departmental geographical maps, chiefly the new 40-mile Wall map of India.

( iii ) *Army Mapping Section.*—This consisted of about 20 draftsmen organized to compile special maps for the Army.

( iv ) *Map Catalogue Section.*—Since October 1949 a section of 11 draftsmen was engaged on the preparation of the new edition of the Survey of India Map Catalogue. In this edition two supplements, one dealing with air photographic cover and the other showing the large scale maps, are being introduced. The new edition is expected to be printed off during 1950-51.

( v ) *Reprint and Reissue Section.*—For a part of the period under report a strength of 20 draftsmen were employed on the reprint and reissue of departmental maps.

( vi ) *Shading Section.*—This section consisting of 4 draftsmen prepared shade originals for departmental maps.

( vii ) *Maintenance and Training Section.*—14 draftsmen trainees completed training in this section in August 1949. Nine Levellers from No. 9 Party were also

given a short course in fair mapping. Nine more trainees entertained in August 1949 are still under training.

( viii ) *Forest Map Section*.—This section of 8 men completed reissues of a number of forest maps besides maintaining office copies of the forest maps belonging to the several contributing States. In addition it undertook paid-for work from non-contributing States in India.

( ix ) *Miscellaneous Section*.—This section with a strength of 12 draftsmen was employed on drawing jobs for special maps, charts and indexes for Central and State Governments and private indentors.

( b ) The drawing of the following geographical and special maps was completed during the period under report :—

( i ) 70-mile Map of India showing the set-up of Indian States under the New Constitution, for issue with the Government of India White Paper on Indian States 1950.

( ii ) 70-mile Political map of India, 1st Provisional Edition 1950, showing Political Divisions in the New Republic.

( iii ) 67·08-mile Railway map of India, 1949 Edition.

The following special maps are in hand :—

( i ) 250-mile Outline map of India.

( ii ) 40-mile Map of India and Adjacent Countries.

( iii ) 40-mile Road map of India.

( iv ) World Aeronautical Charts—International Civil Aviation Organization 1 : 1,000,000 scale charts Delhi, Allāhābād, Patna, Rajkot, Gauhati, Trivandrum, Barcilly, Nāgpur, Calcutta, Hyderābād, Bangalore, Madras.

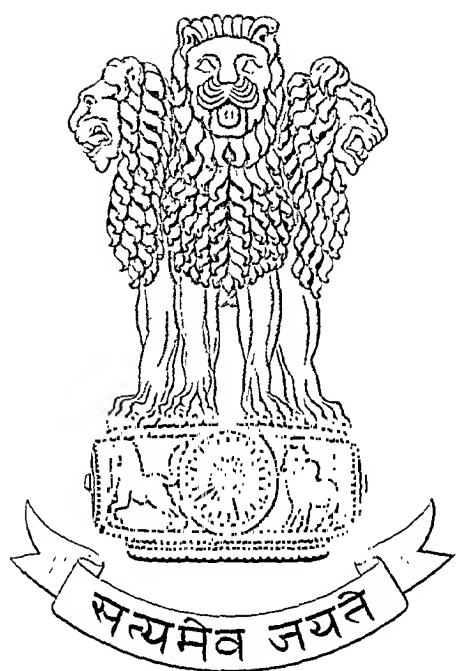
( v ) HIND 5014 Series sheets of India on 1:500,000 scale for the Defence Services.

122.—No. 2 Drawing Office, Dehra Dūn.—The main work of this unit consisted of the compilation, reissue and accessory drawing work for reprints of topographical maps. A few HIND 5014 sheets for the Geographical Section of the General Staff Branch, Army Headquarters, were also prepared.

The Map Record Section of this Office carried out its normal function of storage of record prints for the Northern Circle area, the originals, and field records of cantonment and special maps and despatch of printed copies of project and other special maps.

123. No. 4 Drawing Office, Bangalore.—The main drawing strength was engaged in carrying out the mapping of departmental standard sheets and on map maintenance work, which involved





*Specimen of engraving work done  
in the Survey of India.*

considerable boundary corrections due to the merger and formation of new States.

A headquarters section to deal with surveys required in connection with minor Development Projects and airfield Landing and Approach Charts in Southern Circle area, continued to be attached to this unit. A report of its activities appears on page 36.

124. No. 5 Drawing Office, Calcutta.—Besides the normal work of reissue and compilation of  $\frac{1}{4}$ -inch topographical maps and reprint of 1-inch and  $\frac{1}{2}$ -inch topographical maps, this office completed a fairly large number of extra-departmental drawing jobs for other Government departments and private indentors.

A few extra-departmental sheets of HIND 5014 series on scale 1:500,000 were also prepared for the Defence Forces, in accordance with the specifications issued by the Geographical Section, General Staff Branch, Army Headquarters, and some are still in hand.

125. Engraving Office, Calcutta.—The main work of the Engraving Office was to bring up-to-date the engraved plates of the 1/M Carte Internationale du Monde Series incorporating the corrections received from maintenance units and Drawing Offices. Two new sheets of the 1/M Carte Internationale du Monde Series were also taken up for engraving.

Besides the above, miscellaneous departmental jobs and a fairly large number of extra-departmental jobs were undertaken for other Government departments and private firms.

126. Summary of Drawing Work.—Table VI which follows, gives the numbers of new maps completed in the various drawing offices and in the field parties during the period under report and also the number in hand at the end of the period.

Table VII gives statistics for the work of map revision and reissue involving the correction to, and incorporation of new material in, existing fair drawn originals of maps.

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## X. WORK OF PRINTING OFFICES

127. Photo-Litho Office, Hathibarkala, Dehra Dūn.—Besides printing the standard departmental maps, a large number of extra-departmental and commercial jobs were printed off during the period under report. Various kinds of lithographic printings, listed below, were executed for other Government departments :—

- ( i ) Posters and folders for the Ministry of Information and Broadcasting, the Chief of Air Staff, Air Headquarters and Post and Telegraph Department.
- ( ii ) Pamphlets, monthly bulletins, Ghee and Butter Agmark labels for the Ministry of Agriculture.
- ( iii ) Technical books for the Chief of Air Staff, Air Headquarters.
- ( iv ) Maps, drawings and plans for the development schemes in India.
- ( v ) Graphs and charts for the Director of Industrial Statistics.
- ( vi ) Railway map for the All-India Railway Time Table.

A wall map of India in Hindi was also printed for the Bhugol Karyalaya, Book publishers, Allāhābad.

The following Printing Machines and Proving Presses were in use :—

### *Lithographic Printing Machines :—*

- One Crabtree Fully Automatic Quad Demy Single Colour Offset with H.T.B. Feeder.
- One Crabtree Fully Automatic Quad Demy Double Colour Offset with H.T.B. Feeder.
- Three Crabtree Fully Automatic Double Demy Double Colour Offset with H.T.B. Feeders.
- One Crabtree Fully Automatic Double Demy Single Colour Offset with H.T.B. Feeder.
- One Mann Fast Three Fully Automatic Quad Demy Single Colour Offset with M.S. Feeder.
- One Mann Fast Five Fully Automatic Quad Demy Double Colour Offset with M.S. Feeder.
- One Mann Standard Double Demy Single Colour Offset ( Hand-fed ).
- Two 'Baby' Mann Fully Automatic Single Colour Offset with H.T.B. Feeders.

### *Lithographic Proving Presses :—*

- Six Furnival Quad Demy Offset Proving and Duplicating Presses.

- One Furnival Quad Crown Offset Proving and Duplicating Press.
- One Furnival Double Demy Offset Proving and Duplicating Press ( Hand Driven ).
- One Mann Quad Demy Deffa.
- One Mann Quad Demy Offset Proving and Duplicating Press.
- One Hoe Quad Demy Flat-bed Proving Press ( Hand Driven ).
- One Hoe Double Imperial Flat-bed Proving Press ( Hand Driven ).

*Plate Making Machine :—*

- One Printex Junior "Step and Repeat" machine.  
( installed in Hathibarkala Litho Office during the period under report ).

128. Photo-Zinco Office, Dehra Dūn.—Apart from printing departmental maps, a fairly large number of extra-departmental maps, such as Cantonment maps, Forest maps, Kwin maps of Burma, Project maps, Bulletins and Charts, etc., for other Government departments were printed during the period.

A total of 17 Indian other ranks ( I.O.Rs. ) were given a training in different trades of map reproduction during the period under report.

The following Printing Machines and Presses were in use :—

*Lithographic Printing Machines :—*

- Two Crabtree Fully Automatic Double Demy Single Colour Offset with H.T.B. Feeders.
- Three Crabtree Fully Automatic Double Demy Double Colour Offset with H.T.B. Feeders.
- One Crabtree Fully Automatic Demy Double Colour Offset with H.T.B. Feeders.
- One Mann Double Demy Single Colour Offset ( Hand-fed ).

*Lithographic Proving Presses :—*

- One Mann Quad Demy Deffa Press.
- Two Furnival Quad Demy Offset Proving and Duplicating Presses.
- One Furnival Double Demy Offset Proving and Duplicating Press.
- Two Mann Double Demy Offset Proving and Duplicating Presses.

129. Photo-Litho Office, Calcutta.—Besides printing the topographical and geographical maps, indexes, charts, etc., for the department and a few HIND Series maps for the Geographical Section, General Staff Branch, Army Headquarters, this office carried out a fairly large number of extra-departmental jobs, such as irrigation and other maps, charts, diagrams, patent specifications, etc., for other Government departments. A large



number of Kwin maps were also printed for the Government of Burma. In addition, a few jobs were also undertaken for commercial firms and the public.

The following Printing Machines and Presses were in use :—

*Lithographic Printing Machines :—*

- One Crabtree Fully Automatic Quad Demy Single Colour Offset with H.T.B. Feeder.
- One Crabtree Fully Automatic Double Demy Single Colour Offset with H.T.B. Feeder.
- One Crabtree Fully Automatic Double Demy Double Colour Offset with H.T.B. Feeder.
- Two Mann Double Demy Hand-fed Single Colour Offset with Chain delivery.
- Two Mann Double Demy Hand-fed Single Colour Offset with chute delivery.
- One Ratcliffe Quad Demy Flat-bed.
- One Mann Double Elephant Flat-bed.

*Lithographic Proving Presses :—*

- One Mann Quad Crown Offset Proving and Duplicating Press.
- One Mann Quad Demy Offset Proving and Duplicating Press.
- One Mann Double Demy Offset Proving and Duplicating Press.
- One Furnival Double Imperial Proving Press.
- Two Furnival Double Elephant Proving Presses.
- One Greige Special Double Imperial Proving Press ( Hand Driven ).
- One Hoe Double Imperial Proving Press ( Hand Driven ).

*Letterpress Printing Machines :—*

- One Dawson and Sons Double Demy Warfedale.
- One Linotype and Machinery Double Crown Centurette.
- One Rockstorch and Schneider Foolscap Victoria Platen.
- One Furnival Crown Folio Platen.
- One Ruling Machine.

130. Letterpress Printing Section, Dehra Dūn.—The following printing machines were in use :—

- Two Payne and Dawson, Double Crown Warfedale.
- One Payne and Otley, Demy Warfedale.
- One Furnival Platen  $13\frac{1}{2}" \times 8\frac{1}{2}"$ .
- One Walker Bros. 'Laurette' Platen—Super Royal.
- Two Hand Presses,  $21" \times 29"$ .
- One Hand Press,  $21" \times 16"$ .
- One Harrild Galley Press,  $28" \times 14"$ .
- One Harrild Compositors Proof Press,  $32" \times 16"$ .
- One Harrild Speedy Proving Press, Double Crown.
- One Stereo Mangle Press.
- Four Monotype Keyboards.

Four Monotype Casting Machines.  
 Two Crosland Guillotine Machines.  
 Two Wire Stitching Machines.  
 One Punching Machine.  
 One Perforating Machine.  
 One Board Cutting Machine.  
 One Blocking Press ( Koh-i-noor ).  
 One Universal Plate Gauge.  
 One Universal Plate Gauge.  
 One Book Back Rounding Machine.  
 One Harrild Hand Lever Card Cutting Machine.  
 One Roller Casting Outfit.  
 Two Kelley No. 2 Printing Presses.  
 One Harrild Rapid Book and Jobbing Folding Machine.  
 One Harrild Electric Casting Box.  
 One Round Corner Cutting Machine.  
 One Precision Trimming Machine.  
 One Book Backing Machine.  
 One Thread Stitching Machine.

131. **Printing Statistics.**—Statistics relating to the various map printing offices of the Department will be found in Section VIII of this part of the report ( page 50 et seq ) and in Table VIII below. Tables IX and X, which follow, give information regarding the out-turn of the Process Engraving and Copper Plate Printing Sections respectively.

Table VIII—Out-turn and Cost of the Photo-Litho Offices

Name of Office	Maps printed (departmental and extra-departmental)	Work other than map—Number of items	Number of Negatives prepared	Number of Zinc printing plates prepared	Number of impressions pulled	Value of out-turn at office rates	Total expenditure of the printing offices during year under report
						Ruppes	Ruppes
1. Dehra Dūn							
Map Publication Office							
(a) Hathi-barkala Litho Office	285	319	4,272	6,965	82,62,481	5,79,047	3,54,568
(b) Photo-Zineo Office	770	80	3,500	4,560	2,358,163	2,57,286	2,59,407
2. Calcutta							
Eastern Circle	378	2,628	3,270	5,276	36,64,754	4,73,100	5,22,305
Total	1,433	3,057	11,042	16,801	14,885,398	13,10,333	11,16,280

Table IX—Out-turn of Process Engraving

Name of the Printing Office	Process Engraving Section			
	Half-tone Work		Line Work	
	Blocks prepared	Impressions pulled	Blocks prepared	Impressions pulled
<i>Dehra Dûn</i>				
Map Publication Office	Nil	Nil	Nil	Nil
<i>Calcutta</i>				
Eastern Circle ..	5	3,535	3	36,000

For impressions pulled see Table X.

Table X—Out-turn of Engraving Office Copper  
Plate Printing Section ( Calcutta )

Impressions pulled			
Chromo Paper	Transfer	Miscellaneous	Total
12,120	..	6,085	18,205

## PART III.—GEODETIC WORK

### **XI. ABSTRACT OF GEODETIC OPERATIONS**

132. General.—Purely geodetic operations include miscellaneous computations and research, preparation and publication of records, observatory work (astronomical, magnetic, seismological and meteorological), measurement of geodetic bases, principal triangulation, geodetic levelling, precise latitudes, longitudes, azimuths, gravity determinations and prediction of tides at 39 ports between Suez and Singapore.

These operations were previously fully described in the annual Geodetic Reports of the Survey of India, but during the war no Geodetic Reports were published except for a short one for 1940. which placed on record only the most important items of geodetic work to safeguard against the risk of their being forgotten altogether. A complete account of all the geodetic work is now regularly published in Part III of the Technical Report of the department. The first volume of this series is for 1947, which covers the period 1st October 1939 to 30th September 1947. The second volume is for 1948-49. This covers the period from 1st October 1947 to 31st March 1949. Subsequent volumes of this series will cover the period corresponding to the financial year, i.e., from 1st April to 31st March.

The following is a brief account of the geodetic operations from 1st April 1949 to 31st March 1950. A fuller account is given in Technical Report, 1949-50, Part III—Geodetic Work.

133. Triangulation.—As mentioned in the previous Report, the precision of the existing topographical triangulation is generally not enough for providing a basis for surveys on scales larger than 1-inch. Consequently the strengthening and extension of the geodetic triangulation and the provision of a sufficiently dense and precise framework to provide scale and azimuth in areas where there is likelihood of large scale work being undertaken has become a pressing necessity. To meet the requirements of such a framework for surveys for the development of the Port of Kandla, during the period under report the old secondary triangulation in Kutch has been reinforced by measuring a new geodetic base near Manaba (about 60 miles north-east of Kandla) and by observing about 100 miles of geodetic triangulation. In addition twin Laplace observations have been made at four stations to control the azimuth.

134. Levelling.—During the period under report 681 miles of levelling of high precision was carried out. Out of the estimated required total of 15,800 miles of levelling of high precision about 4,000 miles still remain to be done.

The existing skeleton High Precision level net is not at all adequate for providing datum bench-marks for secondary and tertiary levelling. To meet the urgent demands of height control data for several irrigation and development projects, 150 miles of precision and 1,032 miles of levelling of secondary precision were run. It is hoped to maintain the progress with this class of levelling in future years.

**135. Gravity.**—Work with the Frost Gravimeter in the priority areas laid down by the Geological Adviser to the Government of India in consultation with the Geological Survey of India is progressing. The preliminary results of the observation in Priority I (Raniganj Coal-fields) area are now available. Work in Priority II (Nagpur) area is in progress, and when this is completed observation will be made in the Priority III (Belgaum) area.

**136. Deviation of the Vertical.**—Astronomical observations for obtaining deflections in the meridian and prime-vertical have so far been carried out at about 1,200 stations spread all over India. These observations are utilized for the evaluation of the geoid. A study of the geoid is important for the problems connected with the figure and the shape of the earth.

Laplace observations, i.e., astronomical observations for latitude, longitude and azimuth were made at 4 stations in the Kandla area for controlling the error in azimuth in the new series of Geodetic Triangulation which has been carried out in that area, see para 133 above.

**137. Magnetic Observations.**—The sanction of the Government has not yet been received for re-starting the Magnetic Observatory at Dehra Dūn, a new site for which has been selected some 15 miles away from the town of Dehra Dūn. A programme of observations at some of the Repeat Stations in South India has been drawn up and will shortly be put into operation. Observatory cover for magnetic field observations is very essential and a vigorous programme of 5-yearly observations at Repeat Stations will be undertaken as soon as the Dehra Dūn Observatory starts functioning.

**138. Computations and Publications.**—Due to the paucity of personnel, the progress of the publication of the grid data triangulation pamphlets for Irāq and Irān has been slow. 5 pamphlets were published during the period under report thus bringing the total of published pamphlets to 21 out of an estimated total of 76. Some progress, has been made with the preparation of complete data triangulation pamphlets for India, and two pamphlets have been compiled.

**139. Headquarters Routine.**—The tidal predictions, the seismographical and meteorological observations at Dehra Dūn have been carried out as usual. A touring tidal detachment carried out 31-day observations at 2 ports for improving the accuracy of tidal prediction.

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## XII. SURVEY REPORTS, GEODETIC AND TRAINING CIRCLE

DIRECTOR, GEODETIC AND TRAINING CIRCLE } Mr. B. L. Gulatee, M.A. ( Cantab. ), from 1-8-49.

PRESIDENT, GEODETIC AND RESEARCH BRANCH } Mr. B. L. Gulatee, M.A. ( Cantab. ).

140. Summary.—The Geodetic and Training Circle now comprises ( i ) Geodetic and Research Branch, ( ii ) Statistical Branch, ( iii ) Training Branch and ( iv ) Instrument Repair Shop.

( i ) *Geodetic and Research Branch.*—The Geodetic and Research Branch deals with the purely geodetic and geophysical activities of the department. These comprise levelling of high precision, secondary levelling, gravimetric and magnetic surveys, tidal observations at ports, geodetic triangulation, high precision traverses and the observation of astronomical latitudes, longitudes and azimuths of a high degree of accuracy. The reduction and interpretation of the results of field observations are carried out during recess.

This Branch is also responsible for the work of the Tidal Office, which prepares and publishes annual Tide-Tables of the Indian Ocean containing predictions of times and heights of high and low water at 39 ports between Suez and Singapore.

Other important functions are the preparation of auxiliary tables for projection of maps, grids and other purposes and computation forms, the adjustment of both geodetic and topographical triangulation, and other survey data, the preparation of pamphlets giving triangulation and levelling data and the editing and proof-reading of technical publications of the Department.

( ii ) *Statistical Branch.*—The maintenance of all geodetic records for the department and issue of all forms of data is the responsibility of the Statistical Branch to which the Geodetic Branch Library is also attached. This Branch is not yet fully organized.

( iii ) *Training Branch.*—The training of all officers of the grade of Surveyors and higher is carried out in No. 15 Party.

( iv ) *Instrument Repair Shop.*—At present only the nucleus of an Instrument Repair Shop exists under the Observatory Section, in which the testing and repair of various kinds of survey instruments has been carried out.

A detailed narrative of the work carried out during the period under report is given in the following pages.

### COMPUTING AND TIDAL PARTY

Officer in charge :— { Mr. C. T. Hurley, to 19-8-49.  
                              { Mr. B. L. Gulatee, M.A. ( Cantab. ), from 20-8-49.

141. Computing Office.—The main task of the Computing Office during the period under report has been the computation

of the field work ( geodetic triangulation, levelling and gravity ), the compilation of triangulation data in Irāq and Irān into pamphlets, the preparation of revised editions of levelling pamphlets, the reprinting of professional forms and the training of computers. A start has also been made with the adjustment of topographical triangulation all over India but due to the shortage of suitably trained personnel the progress has been very slow and adjustment of data for two  $\frac{1}{4}$ -inch sheets ( 54 A and 47 F ) only could be carried out.

**142. Tidal Section.**—The annual “Tide-Tables of the Indian Ocean” and the three separate pamphlets for Bombay, the Hooghly River and the Rangoon River for the year 1950 were prepared and published. Advance predictions for the year 1951 for a number of ports were sent to the Hydrographic Departments in England and the United States and to the Indian Navy, as usual. Advance predictions for 1952 are in hand.

Harmonic analysis of observations at Kandla Jetty and predictions for the period November 1949 to December 1950 have been carried out at the request of the Resident Engineer, Kandla.

Harmonic analysis of the field tidal observations at Port Okha, Mandvi, Porbandar and Bhāvnagar during 1948–49 was also carried out.

Predictions for Lower Saugor ( about 40 miles seawards off Saugor at the mouth of the Hooghly River ) for 1939 were also run off on the machine to provide necessary data required for the working of Hooghly River Model at Khadakvasla.

Registrations with automatic gauges were continued by the port authorities at Aden, Bombay ( Apollo-Bandar ), Vizagapatam and Calcutta ( Kidderpore ). The Kent's Pneumatic gauge at Dublat ( Saugor ), Gangra, Balari and Diamond Harbour installed by the Calcutta Port Commissioners continued operation during the period under report. Daylight observations of high and low-waters on tide-poles were also continued at Bhāvnagar and Rangoon.

There is an automatic tide-gauge at Karāchi and daylight observations only on tide-poles are taken at Chittagong. Reports from these places have not been received since March 1948.

The touring tidal detachment took 31-day observations at Navlakhi in the Gulf of Kutch and at Navi Wat in the little Gulf of Kutch during the period under report.

The International Union of Geodesy and Geophysics has recommended the establishment of a number of additional permanent tide-gauge observatories on the coast of India. Action is being taken to implement this resolution and the necessary tide-gauges for the purpose are being procured.

**143. Observatory Section.**—The principal work of the Observatory Section consisted of the usual seismological and meteorological observations, the comparison and maintenance of standards of length, the instruction of officers in astronomical observations, the

maintenance of delicate scientific instruments and the issue of instruments, stores and equipment to the various field detachments of the Circle.

The Survey Star Almanac for the year 1950 was also compiled and published.

The Central Board of Geophysics has recommended to the Government of India that a magnetic observatory at a new site about 15 miles away from Dehra Dūn should be built but the financial sanction of the Government has not been received so far.

Financial sanction has also not been received for starting a new seismological observatory in the compound of the Geodetic Branch, Survey of India, Dehra Dūn, which is to be equipped with modern seismological instruments to be supplied by the Meteorological Department.

144. **Instrument Repair Shop.**—During the year 356 instruments of various kinds were tested and calibrated. The main calibration has been of 20-metre Invar tapes for field units which were compared against bays 1-6 of the 24-metre comparator. The other instruments calibrated were theodolites, tapes, levels, barometers, Invar levelling staves for precision work and chronometers.

Repairs to 346 instruments ( 17 Glass Arc Theodolites, 2 Geodetic Tavistocks, 28 Vernier Theodolites, 3 Chronometers, 33 Levels, 10 Levelling Staves, 97 Aneroid and Paulin Barometers, 13 Calculating Machines, 54 Magnetic Compasses, 10 Clinometers, 36 Clocks, Watches and Timepieces, 25 Binoculars, 16 Wooden Head Stereoscopes, 1 Gestetner Machine and one Hand Camera ) were carried out.

145. **Geodetic Triangulation.**—There are numerous urgent demands now-a-days on the department for large scale maps and one of these is in the Kāthiāwār area for the development of the Port of Kandla. This area has so far not been covered even by 1-inch modern survey. Two secondary series Kutch Coast Series ( No. 35 ) and Kutch Coast-line Series ( No. 39 ) run through the area. The precision of these series is not sufficiently high to provide an accurate framework for large scale surveys. These series have consequently been strengthened by the measurement of a geodetic base and the observation of Laplace stations at four places. About 100 miles of the old secondary triangulation which had large triangular errors has also been reobserved.

Another important demand for the provision of geodetic framework is that in the Andamans Islands. A scheme for the observation of a series of geodetic triangulation and a line of precise levels has been prepared. It is hoped to reconnoitre the sites for the base measurement and the placing of stations and bench-marks and to carry out the observations during the coming cold weather.

About one-third of the geodetic triangulation of India is of secondary quality, which needs reobservation and strengthening. Some of the stations are over a century old and have been destroyed



and can only be restored by observations to surrounding stations. In the plains of India high towers had to be erected to secure visibility of rays and most of these towers have either totally crumbled down or have otherwise become unusable.

During the coming field season it is proposed to send out a detachment to visit the G.T. Stations in areas which are likely to be resurveyed in the near future and to prepare a comprehensive report for their restoration. It will, however, be some time before a vigorous programme of systematic geodetic triangulation and primary traverse can be started. Observers are being trained in precision base measurements and in the use of geodetic theodolites. Experiments are also being made with the use of portable Bilby-Steel towers in places where the existing tower stations have fallen down, the cost of high masonry towers being prohibitive. It is also hoped to replace the archaic Argand lamps, which work with kerosine oil by electric signal lamps.

#### No. 14 PARTY

*Officer in charge* :— { Mr. F. M. Hawley, from 15-6-49 to 12-7-49.  
Mr. N. L. Gupta, C.E., from 13-7-49 to 13-11-49.  
Mr. B. L. Gulatce, M.A. ( Cantab. ), from 14-11-49 to 30-11-49.  
Mr. J. C. Ross, from 1-12-49.

146. General.—This party was organized to control levelling field work. Mr. N. L. Gupta, remained on sick leave practically throughout the field season and the supervision of the technical work of this party was carried out by Mr. C. B. Madan, Officer Surveyor, and the administration by Mr. J. C. Ross.

Eight levelling detachment were formed, two of them were employed on levelling of High Precision, one on levelling of precision and five on secondary levelling.

147. High Precision and Precision Levelling.—The following lines of levelling were carried out during the period under report :—

- ( i ) High Precision levelling from Balasore to Jaleswar in the fore direction.
- ( ii ) High Precision levelling from Jaleswar to Howrah in the back direction.
- ( iii ) High Precision levelling from Karwar to Hubli in the back direction.
- ( iv ) High Precision levelling from Vizagapatam to Raipur in the back direction.
- ( v ) Precision levelling from Howrah to Parbasthali.
- ( vi ) Precision levelling from Calcutta Mint to King George Dock and
- ( vii ) Precision levelling from Calcutta Mint to Cossipore.

Lines ( iii ) and ( iv ) above were carried out as part of the departmental programme of high precision levelling and have added

683 miles to the mileage of the Now Level net, which now stands at 11,600 miles. The estimated total mileage of this net when complete is 15,800 miles.

Lines (i), (ii) and (v) to (vii) above were carried out at the request of the River Surveyor to the Commissioners for the Port of Calcutta for providing height datum for his tide-gauge stations.

148. River Crossings.—In the precision levelling carried out for the River Surveyor to the Commissioners for the Port of Calcutta from Diamond Harbour to Dublat it was necessary to cross the Hooghly at two places where the span of the river was 1.67 miles. At these places there were no bridges and the levelling was carried across by the leveller by methods which were not free from doubt. A special River Crossing Detachment was, therefore, organized and carried out levelling by means of vertical angles and double target methods at these sites and provided reliable values.

149. Secondary Levelling.—The following lines of levelling of secondary precision were run to provide height datums for various irrigation and development projects :—

- ( i ) 50 miles for the Executive Engineer, Lower Narbada Division, Hoshangābad.
- ( ii ) 230 miles, from Hoshangābād to Jubbulpore for the Bargi Dam Project for the Executive Engineer, Upper Narbada Division, Jubbulpore.
- ( iii ) 365 miles for the Gandak Project for the Superintending Engineer, Gandak Circle, Patna.
- ( iv ) 340 miles for the Kosi Project for the Chairman, Central Waterpower, Irrigation and Navigation Commission, Now Delhi.
- ( v ) 47 miles for the Development Commissioner for the Port of Kandla, Bhuj.

### STATISTICAL BRANCH

150. General.—The formation of a Statistical Branch to deal with the co-ordination, compilation and publication of all kinds of geodetic and geophysical data has been sanctioned by the Government of India with effect from 1st August 1949. Due to the paucity of suitable personnel, this branch is not fully organized as yet. Some of the important functions of this Branch are :—

- ( i ) publicity for the work carried out by the Geodetic and Training Circle,
- ( ii ) organization and supply of all forms of data ( triangulation, traverse, levelling, tidal, gravity, magnetic and astronomical, etc. ) to departmental and extra-departmental indentors,
- ( iii ) the systematic cataloguing of all literature of survey interest received in the Geodetic Branch Library.

- (iv) the preparation, publication and distribution of technical and professional papers,
- (v) arranging for the preservation and maintenance of about 3500 G.T. stations and 2000 Primary Protected Bench-marks,
- (vi) the construction of new G.T. stations and Primary Bench-marks, and
- (vii) allotting of priorities for the printing of departmental publications.

151. **Technical Publications.**—Besides a number of triangulation and levelling pamphlets, Technical Report 1948-49, Part III—which contains a detailed account of the geodetic work of the Survey of India, and Technical Paper No. 3, "LEVELLING IN INDIA—PAST AND FUTURE", were prepared and published.

152. **Training in Secondary Levelling.**—As a result of the interest stimulated by Technical Paper No. 3, several enquiries for training in levelling have been received and two officers deputed by the Government of Madras were trained.

153. **Liaison with Marine Survey of India.**—Close liaison has been established with the Marine Survey of India, which has agreed to tie up their levelling and triangulation work to that of the Survey of India and to exchange other information. The records of tidal observation at various ports by the Marine Survey of India are likely to be great use for improving the quality of tidal predictions.

### No. 15 PARTY

*Officer in charge* :— { Mr. K. L. Dhawan, B.A., from 1-8-49 to 20-11-49.  
                                   { Mr. B. L. Gulatee, M.A. (Cantab), from 21-11-49 to 30-11-49.  
                                   { Mr. J. C. Ross, from 1-12-49.

154. **General.**—The instructing staff of the training party consisted of 1 Class I Officer, 2 Class II Officers, 1 Surveyor and two Survey Assistants. 5 clerks were attached for correspondence and accounts and an average strength of 120 Class IV servants was employed. The headquarters of this unit remained at Dehra Dūn throughout the period under report.

155. **Training.**—The party is fully equipped for imparting intensive training in survey methods and has also arrangements for training in air survey. The primary object being to train departmental officers of the grade of Surveyor and above, only a limited number of candidates from outside can be taken. Advantage has been taken of the training facilities in the past by Burma and Afghan Governments and some State administrations.

The syllabus of training extends over two years and covers drawing, plane-tableing on various scales, triangulation, traversing, levelling, astronomical observations for latitude and azimuth and Air Survey. The broad outlines of geodetic and geophysical subjects are also explained and demonstrated. It is intended to revise

the programme of training to conform to the syllabus laid down for the Land Survey Division of the Royal Institution of Chartered Surveyors. The establishment of a similar Institution of Surveyors (India) is under the consideration of the Government and when this comes into being the course of study in the Survey of India Training Party will cater for the needs of all candidates wishing to sit for the Intermediate and Final examinations of the Land Surveying Division of this Institution.

During the period under report the following officers remained under training :—

- ( i ) 4 R.I.E. Officers, two of whom were reverted to Military duty,
- ( ii ) 3 Class II probationers.
- ( iii ) 6 temporary Surveyors and Computers,
- ( iv ) 3 Junior Commissioned Officers, Military Survey Service,
- ( v ) 5 Officers deputed for training by the Government of Burma.



## INDEX MAPS

- A. Modern Topographical Surveys and Compilation.
  - B. Modern Topographical Survey and Revision.
  - C. Index showing Project Surveys in hand.
  - D. Maps published on scales of one-inch and half-inch to one mile.
  - E. Maps published on scale of quarter-inch to one mile.
  - F. Index to the maps of the I/M Carte Internationale du Monde Series.
-